Published in final edited form as:

J Sex Med. 2018 July ; 15(7): 1030–1033. doi:10.1016/j.jsxm.2018.05.001.

Rear Tip Extenders and Penile Prosthesis Rigidity: A Laboratory Study of Coloplast Prostheses.

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Abstract

Introduction: Rear tip extenders (RTEs) are used commonly in penile prostheses, but their effect on erectile rigidity has not been extensively studied.

Aim: To determine whether RTEs affect erectile rigidity in inflatable penile prostheses and determine what length of RTE should be used for a given corporal length – in this case, 22cm.

Methods: To assess the effect of RTEs on erectile rigidity, we created a penile model simulating two corpora cavernosa that accommodated cylinders of varying lengths (Figure 1). Once the cylinders were inflated, a 200g weight was then uniformly placed on the tip of the cylinders and deflection was measured using a ruler (Figures 2 & 3). Measurements were repeated for varying cylinder/RTE lengths to total 22cm of overall corporal length.

Main Outcome Measures: Differences in rigidity and angular deflection based on RTE length.

Result(s): Increasing the length of RTE's increased the deflection in our model (Table 1), indicative of decreased axial rigidity.

Conclusion(s): An IPP represents a heterogeneous beam given that it is composed of a non-inflatable rear combined to an inflatable cylinder. In this model greater bending deflection was associated with more RTE length. Greater RTE length decreases the size of the inflatable device that can be implanted. The erect penis is subject to axial stress and bending deflection. Though further work is needed, this data supports the notion that maximizing inflatable length by minimizing RTEs will improve overall erectile rigidity dynamics.

Keywords

rear tip extender; inflatable penile prosthesis; rigidity; model

Introduction

The inflatable penile prosthesis (IPP) has evolved over the past four decades and become a reliable, safe surgical treatment option with high patient satisfaction rates [1–3]. Rear Tip Extenders (RTEs) were introduced in 1981 [4], in an effort to decrease input wear on the cylinders. RTEs were initially thought to improve appropriate cylinder sizing and mechanical survival [5]. Recent data have shown that RTEs are placed in 53 to 68% (16,354/24,180) of implants and that the use of RTEs has increased from 2010 to 2015 in the percentage of IPP placements, from 6–8% in 2000 to 93% in 2015 [6,7]. Though RTE use is common, their effect on erectile dynamics is undocumented. Axial rigidity has been shown previously. Thus, we sought to measure the effect of RTE on angular deflection in a laboratory model. We hypothesize that increasing length of rear tips for a given corporal length will lead to increased axial bending of prosthesis cylinders.

Methods

The link between RTE use and cylinder deflection was evaluated using a penile model simulating the corpora cavernosa, created using a 3D printer. The model was created using a model of a human pelvis and reflected both the length and angle of orientation of the crus for a man in the standing position. The model itself is made of hard plastic and could accommodate prostheses' inflatable cylinders of varying lengths. This rigid holder is an approximation of the suspensory ligament acting on the cylinder at a set location. Coloplast Titan cylinders were attached to a pressure monitor and inflated to 15 psi (Figure 1), with the reservoir in place. This pressure was determined from the median pressure used in a previous study [8]. A 200g weight was then uniformly placed on the tip of the cylinders at the same distance from the pelvic model and the deflection was measured using a ruler (Figures 2 & 3). Al Ansari et al showed that the mean axial pressure to bend the implanted penis was 984.8 ± 268.7 grams [9]. 200g was chosen to reflect a weight significantly less than the pressure on the erect penis during sexual activity. Different cylinder sizes and RTE lengths were tested, all totaling 22cm in length. Measurements were taken for cylinders of 22cm, 20 + 2cm RTE, and 18 + 4cm RTE.

Results

Current IPP cylinder design is a hybrid of rigid and inflatable implant. For example, a Coloplast Titan® cylinder has a 5cm rigid non-inflatable portion. Adding RTEs increases this non-inflatable portion of implant (Figure 4). In addition, adding more RTEs decreases the size of the inflatable portion of the implant that can be placed in a certain patient, or for a certain corporal length. In our penile model, increasing the length of RTEs increased the deflection (Table 2) due to axial pressure. In a 22cm implant with no RTE's, downward deflection was 5.5 cm. However, downsizing the implant to 18cm and adding 4cm of rear tips increased the downward deflection to 15.5 cm, a 10cm deflection. This data supports the

notion that maximizing inflatable length by minimizing RTEs will improve overall erectile rigidity dynamics.

Discussion

The inflatable component more closely mimics a natural erection from a patient's perspective. As such, maximizing this component of the implant provides maximal benefit to the patient. No specific patient complaints about rear tips have been noted, either anecdotally from the authors or in the literature, when not dislodged or infected. However, patients may not complain of decreased rigidity in erections secondary to rear tips as most patients receiving IPPs have had significant erectile dysfunction to begin with. As such, any erectile rigidity provided by the IPP is a significant improvement for these patients. Even though patients may not complain, investigating ways to further improve erectile quality and rigidity is warranted.

Similar ex-vivo models have been used to test the biomechanical properties of penile prostheses. For example, Scovell et al. compared the AMS 700LGX and the Coloplast Titan prostheses using both single longitudinal column compression load to mimic penetration, and horizontal rigidity to estimate the resistance to bending[8]. In their model, both the deflection angle and length of deflection were recorded. The authors tested devices of different lengths from both manufacturers. However, they did not measure the effect on rear tips on these parameters, as we have done.

Though to our knowledge, this is the first manuscript evaluating the effect of RTEs on erectile rigidity, our study has several limitations. Our work represents exploratory study rather than a randomized trial. As such, caution should be taken prior to applying these findings ubiquitously into clinical practice. For the Coloplast devices, going from a 22 cm device to a 20cm device also decreases the diameter slightly. As such, the decreased axial rigidity with increased rear tips could hypothetically be due to the both decreased length and/or girth of the inflatable component. The decrease in girth when going from 22cm to 20cm cylinders is only 1mm, and likely plays a much smaller role. Given we only used Coloplast devices, our data hypothetically only applies to those devices. However, we suspect the general principle will be more widely applicable.

The ability of our in vivo model to predict in vivo needs, which are much more variable, is unknown. May factors could affect the axial bending of implants in vivo, including the formation of a pseudocapsule, differences in the tunica, how much patients inflate their prosthesis, and the exact size of the individual patient's implant. The pressure or resistance to axial bending that is noticeable to patients is unknown, and likely varies significantly from patient to patient.

Lastly, it is important to differentiate between limiting RTE's while maintaining the same implant length, and under sizing an implant. When additional length is needed to appropriately size an implant, but there is not enough length to use a larger device, then RTE's have a role in bridging that gap. The current study and manuscript focus on limiting RTE's when an inflatable implant of larger size can be used to fill that same space.

Conclusions

Rear tip extenders are one of many components developed over the evolution of inflatable penile prostheses. Our data indicate that minimizing their use and maximizing the inflatable portion of the device may more closely approximate natural erection. Further work is needed to fully validate and confirm these findings both in the lab and in patients, if possible. Future advances in penile prosthetic technology should focus on maximizing rigidity by minimizing the length of the fixed portion of the cylinders.

Acknowledgments

This work is supported in part by the Multidisciplinary K12 Urologic Research (KUR) Career Development Program awarded to Dolores J Lamb (NT is a K12 Scholar).

References

- [1]. Chung E, Solomon M, DeYoung L, Brock GB. Clinical outcomes and patient satisfaction rates among elderly male aged 75 years with inflatable penile prosthesis implant for medically refractory erectile dysfunction. *World J Urol* 2014;32:173–7. doi:10.1007/s00345-013-1102-7. [PubMed: 23708698]
- [2]. Chung E, Solomon M, Deyoung L, Brock GB. Comparison between AMS 700 CX and Coloplast Titan Inflatable Penile Prosthesis for Peyronie's Disease Treatment and Remodeling: Clinical Outcomes and Patient Satisfaction. *J Sex Med* 2013;10:2855–60. doi:10.1111/jsm.12009. [PubMed: 23210973]
- [3]. Lledó-García E, Jara-Rascón J, Moncada Iribarren I, Piñero-Sánchez J, Aragón-Chamizo J, Hernández-Fernández C. Penile Prosthesis First and Replacement Surgeries: Analysis of Patient and Partner Satisfaction. *J Sex Med* 2015;12:1646–53. doi:10.1111/jsm.12932. [PubMed: 26193766]
- [4]. Scarzella GI. Cylinder Reliability of Inflatable Penile Prosthesis: Experience with Distensible and Nondistensible Cylinders in 325 Patients n.d
- [5]. Malloy TR, Wein AJ, Carpiello VL. Improved Mechanical Survival with Revised Model Inflatable Penile Prosthesis using Rear-Tip Extenders 1982;128:489–91. doi:10.1016/S0022-5347(17)53009-8.
- [6]. Cordon BH, Eid JF. 041 Differences in the Utilization of Rear Tip Extenders for Inflatable Penile Prosthesis Amongst Different Volume Implanters. *J Sex Med* 2017;14:e20–1. doi:10.1016/j.jsxm.2016.12.054.
- [7]. DeLay K, Gabrielson A, Yafi F, Hellstrom W. Pd22–06 Rear Tip Extenders During Inflatable Penile Prosthesis Placement: Impact on Need for Revision. *J Urol* 2017;197:e443–4. doi: 10.1016/j.juro.2017.02.1057.
- [8]. Scovell JM, Ge L, Barrera EV, Wilson SK, Carrion RE, Hakky TS. Longitudinal and Horizontal Load Testing of Inflatable Penile Implant Cylinders of Two Manufacturers: An Ex Vivo Demonstration of Inflated Rigidity. *J Sex Med* 2016;13:1750–7. doi:10.1016/j.jsxm.2016.09.015. [PubMed: 27770856]
- [9]. Al Ansari A, Talib RA, Canguven O, Shamsodini A. Axial penile rigidity influences patient and partner satisfaction after penile prosthesis implantation. *Arch Ital Di Urol E Androl* 2013;85:138. doi:10.4081/aiua.2013.3.138.
- [10]. Hakky T, Barrera EV, Ge L, Pastuszak AW, Wallen J, Carrion RE, et al. 122 In-vivo Biomechanical Comparison of the Effects of Rear Tip Extenders on Penile Implants 2018. doi: 10.1016/j.jsxm.2017.11.081.

Figure 1 –.
Penile Model

Figure 2 –.
Starting measurement of penile model without weight.

Figure 3 –.
Deflection with 200-g weight.

Figure 4 –.
Adding rear tip extenders increases the non-inflatable portion of the cylinder.

Table 1 –

Deflection vs length of rear tip extender.

IPP	Initial Height	Final Height	Deflection
22cm + 0 RTE	22.8	17.3	5.5
20cm + 2cm RTE	23	13.75	9.25
18cm + 4 cm RTE	23.5	8	15.5