MEN'S SEXUAL HEALTH

Attitudes Toward Penile Transplantation Among Urologists and Health Professionals

Bobby Najari, MD,[1,*] Ryan Flannigan, MD,[2,*] Jackson Hobgood, BSc,[3] and Darius Paduch, MD, PhD[2,4]

ABSTRACT

Introduction: Penile transplantation, in its infancy, has the potential to reestablish functional outcomes for men with penile loss and disfigurement. However, significant bioethical considerations are pertinent, and systematic discussions are necessary to safely progress implementation.

Aim: To determine the attitude of health practitioners toward the penile transplant and identify the key aspects of concern pertinent to the operation and clinical care.

Methods: Health care professionals from the United States responded to either email invitation, web link, or social media post on Facebook to complete a questionnaire investigating perceptions and attitudes toward penile transplantation.

Main Outcome Measures: Respondents' attitude toward penile transplantation, their own perceived important functions of the penis, and concerns about performing a penile transplantation. Respondents' previous exposure to visceral transplants, to penile disfigurement, and information about penile transplants were used as independent factors in analysis.

Results: Among 412 health care professionals who responded to the questionnaire, 95.9% were in favor of visceral organ transplant, but only 64.3% were in favor of penile transplantation. The results showed that 61.3% of respondents first learned about the penile transplant from mass media, whereas only 37.5% had been exposed through a scientific journal, formal lecture, or a professional colleague. Younger health professionals and those exposed through professional forums surrounding penile transplantation were more likely to be in favor of the procedure ($P < .001$). The most important functions of the penis were identified by respondents as being sexual function (role in sexual activity) and gender identity (being a man) with rates of 86.4% and 85.3%, respectively ($P < .001$). Barriers identified by respondents included the use of immunosuppression and the potential subsequent effect on healthcare resource utilization. Reading an excerpt about penile trauma in war during the questionnaire improved acceptance of penile transplantation ($P = .05$).

Conclusion: Penile transplantation is accepted by most health professionals surveyed. Younger respondents and those informed through professional outlets are more favorable toward penile transplantation. Anticipated limitations include the risk of immunosuppression, lack of available donors, and the effect on healthcare utilization. **Najari B, Flannigan R, Hobgood J, et al. Attitudes Toward Penile Transplantation Among Urologists and Health Professionals. Sex Med 2018;6:316–323.**

Key Words: Penile Transplant; Penile Trauma; Genitourinary Trauma; Penile Reconstruction

Received March 20, 2018. Accepted June 7, 2018.

[1]New York University, New York, NY, USA;

[2]Weill Cornell Medicine, Department of Urology, New York, NY, USA;

[3]East Tennessee State University, Johnson City, TN, USA;

[4]Consulting Research Services, Inc, North Bergen, NJ, USA

*Equal Contribution

https://doi.org/10.1016/j.esxm.2018.06.003

INTRODUCTION

Solid organ transplants have become a foundational therapy for many forms of end-stage organ dysfunction such as hepatic, renal, respiratory, cardiac, and pancreatic failure. These transplants have been shown to decrease mortality, prolong life, and be cost effective in some circumstances, such as renal transplant.[1] Awareness of visceral organ transplantation is increasing as is the frequency; in 2015, a record number of 30,974 solid organ transplants were performed in the United States.[1]

Transplants have been traditionally life-saving, but more recently, the field of organ transplantation has extended to also include organs for the functional benefit. Composite tissue allotransplantation (CTA) is comprised of heterogeneous cadaveric tissues and has advanced the field to include transplantation of organs to restoration, function, structure, and aesthetics.[2] Examples of CTA include face, abdominal wall, larynx, tongue, knees, and penis.[1,3,4] These structures are not life-saving in many cases but potentially contribute to the quality of life of their recipients. Transplant is not without complication, and there are side effects related to the procedure or associated immunosuppression. Thus, assessment of the risk-to-benefit tradeoff for non-life-threatening CTAs is an important consideration and significant controversy exists.[5,6]

Within this realm, the experience and realization of penile transplantation is rapidly evolving. Although guidelines do not yet exist and indications are in its infancy, conceivable indications for men include those with penile amputation or severe disfigurement and functional loss of male genitalia. Here, penile loss may occur most often due to trauma or penile cancer with subsequent penectomy. Because the penis is an external appendage, it is at risk for trauma in military combat. In fact, complex genitourinary injuries have emerged as a common occurrence in current military combat operations.[7] Operation Enduring Freedom (OEF) in Afghanistan and Operation Iraqi Freedom (OIF) have become the longest wars of modern times, resulting in more than 50,000 service members sustaining major injuries. Changes in combat tactics have doubled the rate of genitourinary trauma from 7% to 13% of injured soldiers.[8] Most service members who endure major lower-extremity amputation from IEDs suffer from major genital trauma.[9,10] In fact, between 2001 and 2013, 1,367 U.S. service members sustained genitourinary trauma with 423 (31%) localizing to the penis.[11] Phallic reconstruction using tubularized flaps can be achieved using a microvascular free forearm flap.[12] Sexual function using a variety of penile prosthetics has been reported following reconstruction; however, these are reports limited to populations of sexual reassignment from female to male transsexual and not combat-related injury victims.[12] Sensory perception of the forearm- or tibia-derived penile flap is lost.[12] Appearance of the penile flap is suboptimal, because the flap does not have a distinct glans, although the technique is continually being refined for better cosmetic appearance.

Penile transplantation allows for restoring both urinary and sexual function by providing a highly functional conduit for urination and a "normal"-appearing and functional organ for sexual intimacy. Three reports of human penile transplant have been published in the literature.[13–15] Furthermore, animal studies have been performed conducting penile transplants in beagles with excellent success.[16] There is no question that penile transplantation for men with catastrophic genital loss is both surgically and immunologically feasible and may be a bioethically justified approach to restore quality of life, urinary function, and sexual function. However, penile transplantation is in its infancy and comes with ethical concerns and warranted discussions. We wished to evaluate the perspectives and attitudes of urologists, reconstructive surgeons, and mental health specialists surrounding the use and potential challenges surrounding penile transplantation. Characterizing and comparing these perspectives are important to evaluate present levels of awareness and education among healthcare professionals that may be involved in clinical and surgical care of these patients. Furthermore, results from this study are necessary to form an initial healthcare provider perspective and consensus on pertinent considerations surrounding penile transplantation, and to direct future working groups that are necessary to establish medical, surgical, and ethical guidance to providers involved in penile transplants moving forward.

METHODOLOGY

Institutional review board approval was acquired for conducting this study at Weill Cornell Medicine. Professionals from across the United States, in numerous fields of medicine, predominantly inclusive urology, reconstruction specialists, and mental health specialists, were asked to complete a survey. Inquiries were made via e-mail invitation, web link, or social media post on Facebook. The online survey was sent to members of the American Urological Association (AUA), members of the New York Transplantation Network, and members of the American Society of Reproductive Medicine using the SurveyMonkey platform. Respondents were asked the following: (1) where they learned about penile transplantation; (2) important functions of the penis; (3) were they in favor of organ donation; (4) were they in favor of transplantation of visceral organs that prolong life (ie, kidney); (5) were they in favor of transplantation of organs that improve quality of life (ie, face); (6) were they in favor of penile transplantation; (7) were they in favor of penile transplantation being covered by a veteran's healthcare plan; (8) concern for issues after transplantation; (9) personal experience with friends or family with penile disfigurement; (10) age; (11) gender; (12) religion; (13) race; (14) ethnicity; (15) service to the military; (16) healthcare profession; (17) in favor of penile transplantation; and (18) withdraw from the study. The responses ranged from "Extremely in favor (1)" to "Not at all in favor (5)" (Appendix 1). Effects of reading an excerpt on penile trauma due to war was assessed during the questionnaire by asking respondents to read an excerpt from the book *Beyond the Battlefield: The War Goes on for the Se*verely Wounded by David Wood, which discusses soldiers' experiences and fears of in-field genital injuries (Appendix 2), prior to responding to question 17: "Are you in favor of penile transplantation"?

IBM SPSS Statistics version 24 was used for data analysis (IBM, New York, NY, USA). Categorical responses were converted to numeric integers to test distribution of answers;

because answers were normally distributed, they were described with mean, median, and interquartile ranges. The Mann-Whitney U tests was used to compare binary variables. Comparisons of parameters with 3 or more variables were done using Kruskal-Wallis H test with a Bonferroni correction for multiple tests. Significance was set at $P < .05$ after Bonferroni correction.

RESULTS

411 subjects completed the survey over the course of 3 months spanning from April 2016 to June 2016 (Table 1). Most respondents were in the field of urology, 97.5%.

Perceived Functional Importance of Penis

Gender identity (being a man) and sexual function (role in sexual activity) with "very important" rates of 85.3% and 86.4% respectively were rated as the most important functions of the penis (Figure 1). Erectile function was also deemed to be a highly important penile function but was rated higher among men than women respondents ($P = .027$). Interestingly, respondents aged 35 to 55 and 55 to 74 were more likely than those aged 18 to 34 years to feel that the function of the penis is for gender identity ($P = .024$, $P = .007$ respectively), which may reflect a shift away from phallocentrism in younger populations.

Favor of Penile Transplants

Most respondents were in "extreme favor" of visceral transplantation (ie, kidney, heart, or liver; 77.3%) and organ transplant in general (60.2%); however, these numbers are reduced to 38% for quality-of-life transplants, and 28.1% for penile transplant (Table 2 and Figure 2). Respondents aged over 75 or those with military experience were less likely to be in favor of general organ transplant than any other age group ($P < .01$, $P = .003$ respectively). Individuals with a personal experience with penile disfigurement were more in favor of visceral organ transplant ($P = .003$) but did not differ with respect to support of other transplant types including penile.

Method of Learning

The results showed that 61.3% of respondents first heard about the penile transplant from mass media while only 37.5% had been exposed through a professional means: scientific journal, formal lecture, or a professional colleague. Respondents who learned about penile transplant through professional means were more in favor of penile transplant ($P = .023$), as well as transplants for quality of life ($P = .043$).

Barriers to Penile as Compared to Visceral Organ Transplant

The most concerning barriers identified by the respondents are the fact that immunosuppression is required, a lack of established sources of cadaveric organ donors, and the potential impact penile transplantation could have on healthcare resource utilization (Figure 3). The least concerning topic related to penile transplant was performing penile transplants for "non-life-threatening conditions." Immunosuppression, healthcare resource utilization, and availability of suitable donor sources were the most concerning potential concerns with penile transplantation. The cost and side effects of immunosuppression were more concerning than all other reasons ($P = .001$); while healthcare utilization was more concerning than transplanting in a non-life-threatening condition ($P < .001$).

Psychological aspects associated with penile transplantation related to intimate relationships were of significant concern for responders. Specifically, not identifying graft as "own" with respect to patient ($P = .009$) or partner ($P = .005$) was more concerning than transplanting for a non-life-threatening condition. Shortage of penile cadaveric donors and partner's acceptance of graft were both important concerns for the responders ($P = .006$; $P < .001$).

Table 1. Baseline characteristics of participants completing the study survey

Demographics	Respondents N (%)
Age	
18–34	50 (12.2)
35–54	188 (45.7)
55–74	139 (33.8)
75+	29 (7.1)
Gender	
Male	346 (84.2)
Female	60 (14.6)
Race/Ethnicity	
White/not Hispanic	315 (76.6)
Black	9 (2.2)
White/Hispanic	20 (4.9)
Asian	46 (11.2)
Other	21 (5.1)
Profession	
Urologist	279 (67.9)
Urologist-Reconstruction	40 (9.7)
Urologist-Andrology	34 (8.3)
Other	58 (14.1)
Military Branch	
Air Force	33 (8.0)
Army	27 (6.6)
Navy	20 (4.9)
Other	6 (1.5)
No Military Experience	325 (79.1)
Religion	
Catholic	101 (24.6)
Protestant	97 (23.6)
Jewish	63 (15.3)
None	99 (24.1)
Other	51 (12.4)

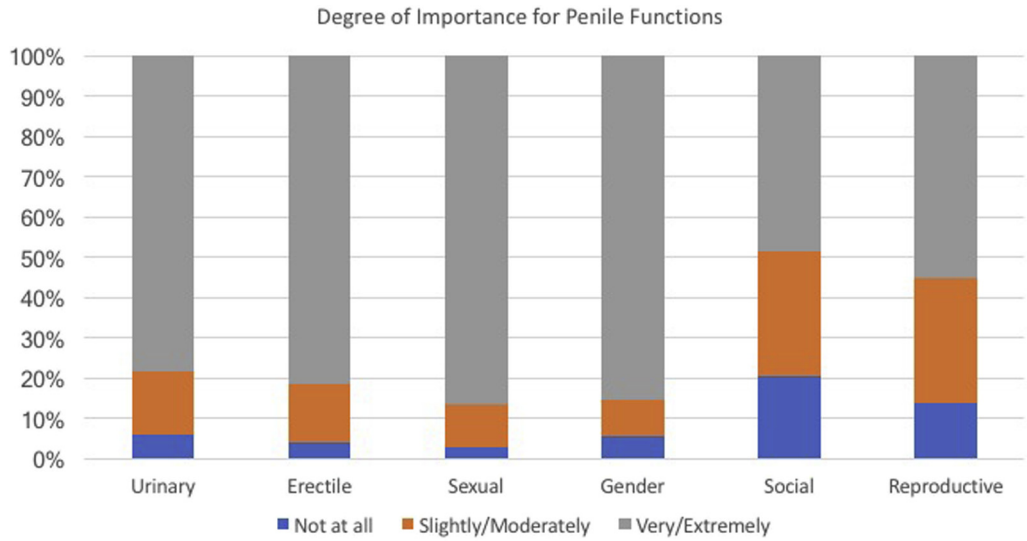

Figure 1. Graph of respondents' answers for their rating of the general importance of each function of the penis (survey question 2). Sexual function followed by gender identity, erectile function, and sexual function were rated most frequently as extremely important functions of the penis. Conversely, social and reproductive function were rated as the least important functions of the penis, significantly less than urinary, erectile, sexual function, and gender identity ($P < .05$).

Coverage of Penile Transplant

The study showed that 65.8% were "very or extremely in favor" of penile transplantation being covered by a veterans healthcare plan. Similarly, respondents that were "not at all in favor" were greatest for penile transplant (8.4%), followed by general transplant (2.5%), quality-of-life transplant (1.2%), and visceral transplant (1.0%) (Figure 4).

Impact of Reading War Excerpt About Penile Trauma

After reading the excerpt from the book *Beyond the Battlefield: The War Goes on for the Severely Wounded* by David Wood (Appendix 2), those in "extreme favor" trended higher from 28.1% to 33.7% ($P = .16$), and those responding "not at all in favor" significantly decreased, 8.4% to 4.8% ($P = .05$; see Figure 4). Furthermore, following the excerpt, respondents that

Table 2. Baseline characteristics of respondents and their favor in penile transplantation

	Respondent in favor of penile transplant? (%)			
	Extremely/Very	Moderately/Mildly	Not at all	*P* value
Total	237 (58.1%)	83 (20.3%)	88 (21.6%)	
Age				.078
18–34	31 (62)	12 (24)	7 (14)	
35–54	100 (53.2)	36 (19.1)	52 (27.7)	
55–74	90 (65.7)	24 (17.5)	23 (16.8)	
75+	14 (48.3)	9 (31)	6 (20.7)	
Gender				.778
Male	202 (58.7)	67 (19.5)	75 (21.8)	
Female	33 (55)	14 (23.3)	13 (21.7)	
Profession				.603
Urologist	156 (56.1)	60 (21.6)	62 (22.3)	
Urologist-reconstruction	21 (53.8)	7 (17.9)	11 (28.2)	
Urologist-andrology	22 (64.7)	5 (14.7)	7 (20.6)	
Other	38 (66.7)	11 (19.3)	8 (14.0)	
Military experience				.325
Yes	44 (52.4)	17 (20.2)	65 (20.1)	
No	193 (59.6)	66 (20.4)	23 (27.4)	
Personal experience with penile disfigurement				.176
Yes	121 (56)	40 (18.5)	55 (25.5)	
No	112 (60.5)	40 (21.6)	33 (17.8)	

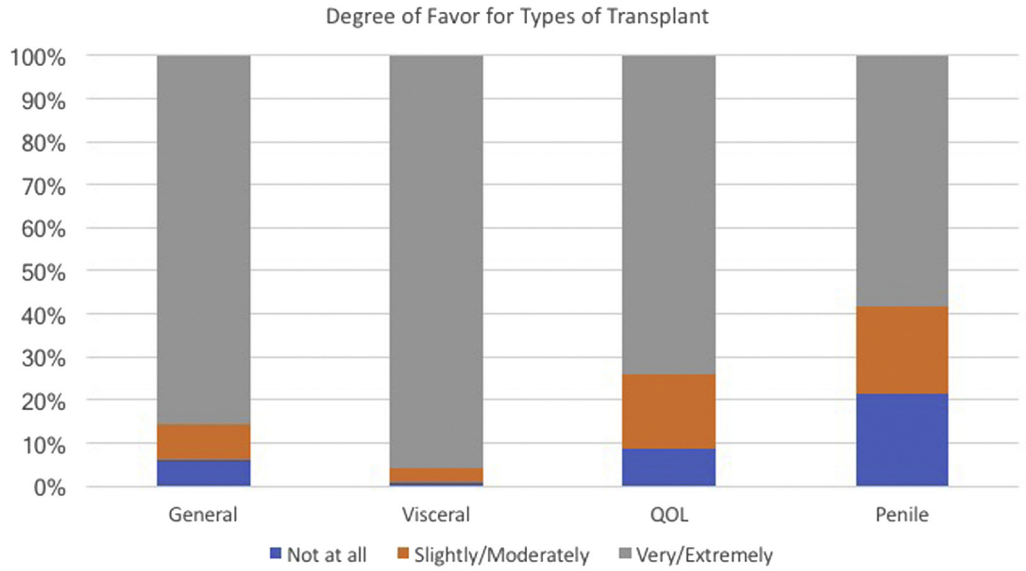

Figure 2. Graph of respondents' favorability toward organ transplant in general, visceral organ transplant, transplants to improve quality of life, and penile transplant. Respondents were most likely to be extremely in favor of visceral organ transplant followed by transplantation in general. Penile transplantation had the least number of responses in extreme favor and was the most likely to have responses of either mildly in favor or not at all in favor, Kruskal-Wallis $P < .001$.

had learned through a professional source were more likely to be in favor of penile transplant than those learning through mass media ($P = .005$).

DISCUSSION

As therapeutic options progress for men with traumatic penile amputation and disfigurement, consideration of both the technical feasibility, as well as the social and ethical implications are vitally important. Technical feasibility hinges on the success of surgical reconstruction and immunosuppression. Surgical reconstruction requires appropriate anastomosis of the urethra, corpus spongiosum, corpus cavernosum, dorsal artery, superficial and deep dorsal veins, dorsal nerve, fascia, and skin.[2] It is unclear if the anastomosis of cavernosal arteries are of benefit.[17] These techniques were initially devised from penile reimplantation,

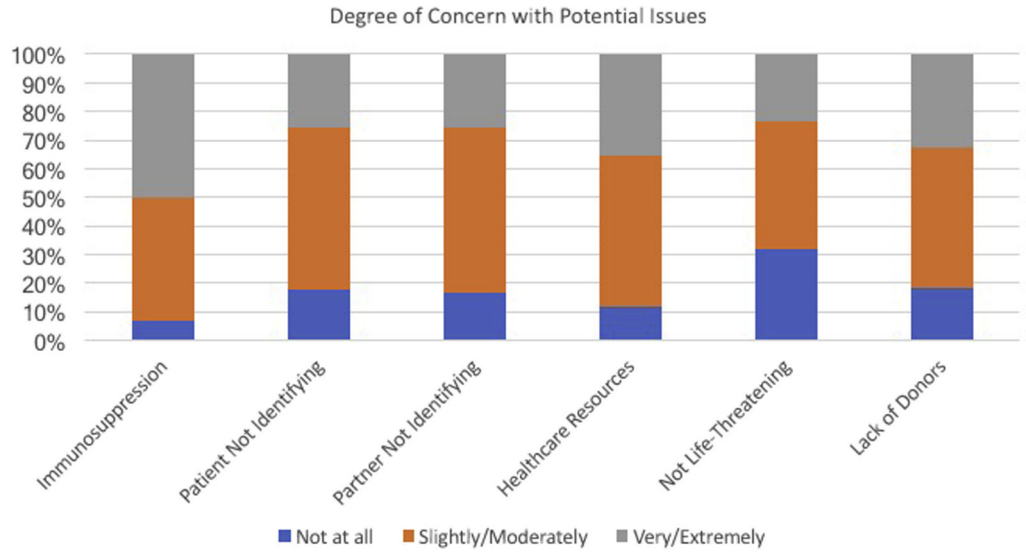

Figure 3. Barriers to transplant. Respondents' concerns expressed for immunosuppression, identifying their graft as not their own, partner not identifying their graft as the patient's, healthcare resource utilization, non-life-threatening condition, or lack of donors. Immunosuppression, healthcare resource utilization, and lack of organ donors were the most concerning potential concerns with penile transplantation. Immunosuppression was more concerning than all other reasons ($P = .001$); while healthcare utilization was more concerning than transplanting in a non-life-threatening condition ($P = .01$) were all more concerning than transplanting for a non-life-threatening condition.

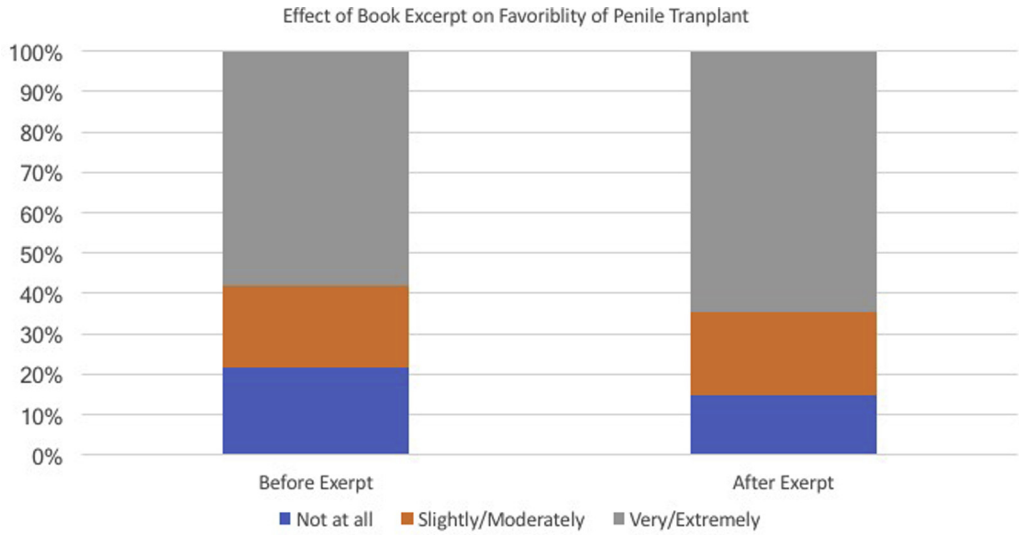

Figure 4. Respondents' responses surrounding their favor of penile transplant at baseline prior to reading the excerpt from the book *Beyond the Battlefield: The War Goes on for the Severely Wounded* by David Wood (Appendix 2) and following reading this excerpt. Pooling responses demonstrate that attitudes were more in favor following having read the excerpt ($P = .025$).

where 28 cases have been reported in the literature, 16 with complications noted. Three penile transplants have been performed to date. Each was technically successful with respect to graft survivability. The first, performed in Guangzhou General Hospital on a 44-year-old man with traumatic penile loss, resulted in a viable graft with some distal penile skin necrosis.[13] However, after 14 days the patient and his wife requested extirpation of the graft because of psychological distress of the aesthetics. No rejection was identified on pathologic examination. The second case, performed in Tygerberg Hospital South Africa for a 21-year-old man with penile amputation secondary to circumcision, required extensive dissection to identify a viable vascular source for the graft using the inferior epigastric and superficial external pudendal arteries. Postoperatively, ancillary procedures were required for thrombosis of the penile artery, infected hematoma, and urethral fistula. The resultant condition is improved psychologic condition, intact penile skin sensation, and erectile function.[14] The third, performed at Massachusetts General Hospital in Boston, MA, on a 64-year-old man who underwent penectomy for penile cancer several years prior. The procedure was 15 hours in duration but resulted in a functional graft with the capability to void but unknown erectile function at this point. An episode of rejection was treated without further complication.[15]

Standard immunosuppression regimens have not been developed specifically for penile transplantation to date. However, 2 published single recipient reports and limited animal data indicate that minimal immunosuppression is needed to prevent the rejection of penile CTA. Based on a single report, standard immunosuppression protocol for renal transplantation (induction with Alemtuzumab followed by tacrolimus (FK-506) and mycophenolate mofetil) seems to be adequate immunosuppression to start in penile CTA transplant. Further studies are needed to assess how the potential benefits of penile transplant compare to the long-term risks of immunosuppression.[18] It is known that the recipient's motivation, compliance, and psychiatric issues affect the outcome of solid organ transplantation.[19] Currently, very limited data exists about the psychological profile of men with total penile and genital loss, as well as the views, attitudes, and beliefs of healthcare providers surrounding penile transplant. This study specifically addresses the latter.

An overwhelming support for visceral organ transplant was noted from the respondents (95.9%). These procedures are often life-saving, involving the heart, lungs, and liver, but they may come at a significant cost to the healthcare system. Other visceral organ transplants such as kidney transplants prolong and improve quality of life and are cost effective compared with the alternative treatment of dialysis.[1] In contrast to visceral organ transplant, respondents were less likely to be in "extreme favor" of CTA transplants for quality-of-life benefit (38.0%) and even less for penile transplant (28.1%), and more were likely to be "not in favor" (8.4%) among penile transplants compared with quality-of-life transplants (1.2%), and visceral transplant (1.0%). This may be due to the presumed risk-to-benefit trade-off perceived by respondents because the primary function of the penis was felt to be sexual function, gender, and erectile and urinary function compared with visceral organs that are required to live. This, coupled with the greatest concerns for penile transplant being immunosuppression and healthcare utilization, it may be felt that penile transplant may lead to health complications that may significantly affect both the recipient's quality and longevity of life in addition to required additional healthcare resources to manage the acquired comorbidities. Furthermore, younger respondents aged 18 to 34 were more likely to be in "extreme favor" of penile transplants (40%) compared with older respondents, which reported similar rates beyond age 35 (age

35–54: 26.2%; age 55–74: 27.9%; age 75+: 20.7%). This may reflect the relative importance of penile function during younger men who may be more focused on sexual relations and reproduction.[20–22] Younger respondents aged 18 to 34 place less importance of the penile function serving as gender identity compared with the older cohorts. This may be a reflection of more awareness of gender diversity among younger cohorts. An alternative explanation may be a shift in phallocentrism ("phallus = masculinity") among millennials. Because respondents older than 75 are less likely to be supportive of organ transplant in general, it may be that older individuals are less accepting of transplantation in general based on their beliefs, understanding, or experiences. Another hypothesis for why penile transplants are not as favored as visceral organ transplants is that most respondents are likely not as well informed with penile transplantation as they are with other forms of more time-tested and established visceral transplantation. For instance, 61.3% of respondents first learned about penile transplantation through mass media, but only 37.5% had been exposed through a scientific journal. Supporting this hypothesis, our results demonstrate that respondents who had learned about penile transplantation through a professional outlet were more likely to favor penile transplant and those transplants working to improve quality of life for these individuals.

Our ability to fully appreciate the extent of the negative effect associated with traumatic loss of one's penis may be difficult to appreciate, and therefore it is difficult to weigh the potential harms and benefits of undergoing a penile transplant. Our data support this hypothesis, because respondents were found to be more in favor of penile transplantation after reading the excerpts of soldiers' thoughts and experiences who have had complex genital trauma. However, this is likely related to empathy and appreciation of the internal psychological struggle of these men, because simply having a personal experience with a friend or family suffering from penile disfigurement did not alter respondents' opinion of penile transplantation.

The results of this study are limited to healthcare professionals and predominately urologists. The insight into the favorability, perceived functions of the penis, and potential challenges with penile transplantation is important to shape future discussions and studies. Furthermore, results from this study are necessary to form an initial healthcare provider perspective and consensus on pertinent considerations surrounding penile transplantation, and to direct future working groups that are necessary to establish medical, surgical, and ethical guidance to providers involved in penile transplants moving forward. Future study populations of interest would include andrologists who perform penile surgery, transplant surgeons, and transplant medicine teams who are directly involved with immunosuppression and the associated complications.

This work has purposefully omitted the study and attitudes toward penile transplantation from the perspective of potential family members and loved ones who would consent to donating intimate organ such as the penis. However, such studies are required to determine the willingness of donor families to determine potential number of suitable organs available for transplantation. Furthermore, targeting the potential patient populations; men with traumatic penile injuries and those having undergone penectomy for penile cancer would add further insight. Previous studies have demonstrated that penectomies have a considerable impact on men's sexual function and relationships, urinary function, masculinity, and mental well-being[23]; similarly, among U.S. military service men with genitourinary (GU) trauma, 40.1% report post-traumatic stress disorder compared with 22.6% without GU trauma, 46% vs 27% report chronic pain, 15% vs 6% report sexual dysfunction, 19.3% report major depression vs 7.1%, 19.6% vs 9.3% report substance abuse, 3.3% vs 1.0% report panic disorder, and 77.5% vs 1.9% have seriously contemplated suicide. It is clear that penile loss in both groups of men results in significant psychological distress and severe impairments to quality of life. However, it will be important to evaluate how these men balance the quality-of-life impairments compared with their perceptions of the potential risks and complications associated with penile transplantation.

CONCLUSION

With the advancement of the penile transplant programs, systematic protocols, and appropriate patient selection criteria on an individual basis, it is theoretically possible to significantly improve function and quality of life in select men. Our study demonstrates that the majority of health professionals are in favor of penile transplantation, albeit less than visceral organ transplantation. The most concerning potential barriers to penile transplantation include the requirement of immunosuppression, potential shortage of donors, and impact on healthcare utilization. Further research is required to assess these concerns, as well as the views of men with a history of penile amputation or disfigurement before widespread implementation.

Corresponding Author: Darius A. Paduch, MD, PhD, Weill Cornell Medicine, Department of Urology, 525 East 68th Street, Starr Pavilion, 9th Floor, Room 900, New York, NY 10065, USA. Tel: 212-746-5309; Fax: 212-746-7287; E-mail: dap2013@med.cornell.edu

Conflict of Interest: The authors report no conflicts of interest.

Funding: This study was funded by the Robert Dow Foundation.

STATEMENT OF AUTHORSHIP

Category 1

(a) Conception and Design
Bobby Najari; Darius Paduch

(b) Acquisition of Data
Bobby Najari; Ryan Flannigan; Jackson Hobgood; Darius Paduch

(c) **Analysis and Interpretation of Data**
Bobby Najari; Ryan Flannigan; Jackson Hobgood

Category 2

(a) **Drafting the Article**
Ryan Flannigan; Jackson Hobgood
(b) **Revising It for Intellectual Content**
Bobby Najari; Darius Paduch; Ryan Flannigan; Jackson Hobgood

Category 3

(a) **Final Approval of the Completed Article**
Bobby Najari; Ryan Flannigan; Jackson Hobgood; Darius Paduch

REFERENCES

1. Santivasi WL, Strand JJ, Mueller PS, et al. The organ transplant imperative. **Mayo Clin Proc 2017;92:940-946.**
2. Rasper AM, Terlecki RP. Ushering in the era of penile transplantation. **Transl Androl Urol 2017;6:216-221.**
3. Hettiaratchy S, Butler PE. Extending the boundaries of transplantation. **BMJ 2003;326(7401):1226-1227.**
4. Hettiaratchy S, Randolph MA, Petit F, et al. Composite tissue allotransplantation—a new era in plastic surgery? **Br J Plast Surg 2004;57:381-391.**
5. Butler PE, Hettiaratchy S, Clarke A. Managing the risks of facial transplantation. **Lancet 2006;368(9535):561-563.**
6. Brouha P, Naidu D, Cunningham M, et al. Risk acceptance in composite-tissue allotransplantation reconstructive procedures. **Microsurg 2006;26:144-149; discussion 149—150.**
7. Williams M, Jezior J. Management of combat-related urological trauma in the modern era. **Nat Rev Urol 2013;10:504-512.**
8. Waxman S, Beekley A, Morey A, et al. Penetrating trauma to the external genitalia in Operation Iraqi Freedom. **Int J Impot Res 2009;21:145-148.**
9. Fleming M, Waterman S, Dunne J, et al. Dismounted complex blast injuries: patterns of injuries and resource utilization associated with the multiple extremity amputee. **J Surg Orthop Adv 2012;21:32-37.**
10. Mamczak CN, Elster EA. Complex dismounted IED blast injuries: the initial management of bilateral lower extremity amputations with and without pelvic and perineal involvement. **J Surg Orthop Adv 2012;21:8-14.**
11. Janak JC, Orman JA, Soderdahl DW, et al. Epidemiology of genitourinary injuries among male U.S. service members deployed to Iraq and Afghanistan: early findings from the Trauma Outcomes and Urogenital Health (TOUGH) Project. **J Urol 2017;197:414-419.**
12. Salgado CJ, Monstrey S, Hoebeke P, et al. Reconstruction of the penis after surgery. **Urol Clin North Am 2010;37:379-401.**
13. Hu W, Lu J, Zhang L, et al. A preliminary report of penile transplantation. **Eur Urol 2006;50:851-853.**
14. Bateman C. World's first successful penis transplant at Tygerberg Hospital. **S Afr Med J 2015;105:251-252.**
15. R. D. Penile transplant: procedure raises technical, ehtical issues. **Urology Times 2016;44:28-34.**
16. Zhao Y, Hu W, Zhang L, et al. Penis allotransplantation in beagle dog. **Biomed Res Int 2016;2016:1489204.**
17. Landstrom JT, Schuyler RW, Macris GP. Microsurgical penile replantation facilitated by postoperative HBO treatment. **Microsurg 2004;24:49-55.**
18. Hu W, Lu J, Zhang L, et al. A preliminary report of penile transplantation: part 2. **Eur Urol 2006;50:1115-1116; discussion 1116.**
19. Heinrich TW, Marcangelo M. Psychiatric issues in solid organ transplantation. **Harv Rev Psychiatry 2009;17:398-406.**
20. Enzlin P, Mak R, Kittel F, et al. Sexual functioning in a population-based study of men aged 40—69 years: the good news. **Int J Impot Res 2004;16:512-520.**
21. Helgason AR, Adolfsson J, Dickman P, et al. Sexual desire, erection, orgasm and ejaculatory functions and their importance to elderly Swedish men: a population-based study. **Age Ageing 1996;25:285-291.**
22. Corona G, Rastrelli G, Maseroli E, et al. Sexual function of the ageing male. **Best Pract Res Clin Endocrinol Metab 2013;27:581-601.**
23. Witty K, Branney P, Evans J, et al. The impact of surgical treatment for penile cancer— patients' perspectives. **Eur J Oncol Nurs 2013;17:661-667.**

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.esxm.2018.06.003.