

Neoclitoral location may affect sexual function in transgender women: a preliminary pelvic MRI study

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Assigned female at birth with anorgasmia possess a smaller clitoral glans and clitoral components farther from the vagina lumen than women with normal orgasmic function. There are no studies evaluating this correlation in operated transgender women. We evaluated whether differences in MRI measurements of neoclitoris volume and distance between the neoclitoris and the neovagina were correlated with differences in sexual function. We recruited for a prospective survey study 40 operated male to female patients (oMtF) who had undergone genital gender affirming surgery and postoperative pelvic MRI. Individual pelvic MRIs were reviewed by two blinded investigators, the three axes of the neoclitoris were measured and the volume was calculated using the ellipsoid formula. The distance between the neoclitoris and the neovagina was also measured. Sexual functioning was assessed using the Female Sexual Function Index (FSFI) and the operated Male to Female Sexual Function Index (oMtFSFI). Mean scores differences in FSFI, oMtFSFI were examined; associations with clitoral size, location, sexual functioning and demographical variables were investigated as well. The response rate was 55%, 11 MtFs operated with pubic neoclitoris technique (PNT) and 11 with neo-urethroclitoroplasty according to Petrović (NCP). The NCP group presented a neoclitoris mean volume of 1.04 (SD 0.39) cc vs 1.31 (SD 0.78) cc of the other group ($p = 0.55$). The mean distance between neoclitoris and neovagina was 4.20 (SD 0.57) cm in the PNT group and 2.55 (SD 0.45) in the NCP group ($p < 0.001$). Patients who had undergone NCP achieved a higher FSFI and oMtFSFI mean Total Score than those operated with the previous technique (FSFI 25.81 SD 3.02 vs 18.62 SD 9.92 $p = 0.08$; oMtFSFI 37.63 SD 8.28 vs 43.36 SD 13.02 $p = 0.23$). According to pelvic MRI measurements, this study suggests a correlation between neoclitoral location and oMtF sexual satisfaction.

INTRODUCTION

Clinical studies have shown that assigned female at birth (AFAB) with anorgasmia possess a smaller clitoral glans and clitoral components farther from the vagina lumen than women with normal orgasmic function [1]. The notion that women's orgasm during intercourse is related to the location of the clitoral glans in relation to a woman's vagina was suggested more than 90 years ago when Marie Bonaparte, using the pseudonym Narjani, published the first data. Bonaparte measured the distance between the underside of the clitoral glans and the center of the urinary meatus and related this distance to the likelihood that the woman would experience orgasm during sexual intercourse [2].

Since only the external clitoral glans is easily accessible for direct measurement, the complete anatomy of the clitoris including the internal corpora, crura, and bulbs has only recently been described, with MRI providing the most sensitive method of distinguishing between the various soft tissue planes [3]. Although adequate sexual function is complex, it was documented that clitoral size and location may be paramount in impacting sexual function [1].

In genital gender affirming surgery (GGAS) also there could be a correlation between sexual function and neoclitoris size and location.

We aimed to evaluate whether differences in MRI measurements of neoclitoris volume and distance between the neoclitoris and the neo-vagina were correlated with differences in sexual function.

MATERIALS AND METHODS

Surgical techniques

Since 1995 more than 350 transgender women have been operated at our Institution using two different techniques: pubic neoclitoris technique (PNT) used until December 2012 and the most recent neo-urethroclitoroplasty according to Petrović (NCP) [4].

Pubic neoclitoris technique included: bilateral orchidectomy, removal of corpora cavernosa of the penis, formation of the neourethra with neomeatus, neovaginoplasty by inversion of penoscrotal skin flaps, construction of the neoclitoris with preservation of the neurovascular bundle and exterior vulva formation. A strip of albuginea, with the penile dorsal neurovascular bundle and a little portion of glans, was prepared, folded on itself, and fixed in the suprapubic area in order to create the neoclitoris (Fig. 1).

Neo-urethroclitoroplasty according to Petrović refinement consists of creating a neoclitoris embedded in urethral mucosa using urethral flaps. The urethral plate is further incised distally in a Y fashion. The urethral flaps are sutured around the neoclitoris to form a neo-urethroclitoris covered by

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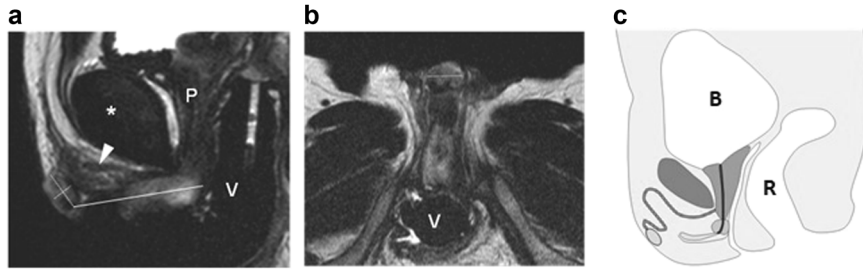


Fig. 1 Pubic neoclitoris technique. Sagittal (a), axial (b) T2-weighted images and (c) scheme showing the post GGAS anatomy: the measurements taken on the neoclitoris (broken lines) and the distance between the neoclitoris and the neovagina (solid line). Asterisk, pubic bone. Arrowhead, neurovascular bundle. V neovagina, P prostate, B bladder, R rectum. A tutor is inserted in the neovagina.

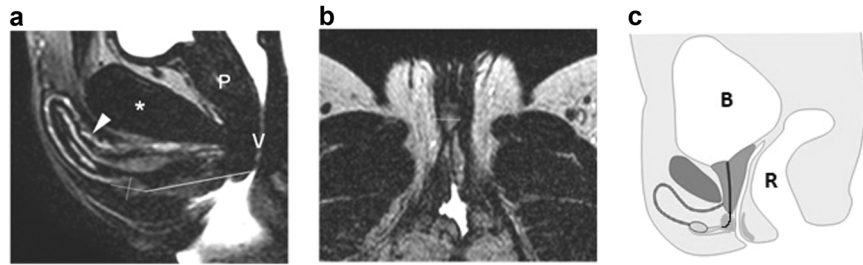


Fig. 2 Neourethroclitoroplasty according to Petrović. Sagittal (a), axial (b) T2-weighted images and (c) scheme showing post GGAS anatomy: the measurements taken on the neoclitoris (broken lines) and the distance between the neoclitoris and the neovagina (solid line). Asterisk, pubic bone. Arrowhead, neurovascular bundle. V neovagina, P prostate, B bladder, R rectum. The neovagina is distended with gel.

urethral neoprepuc, which resembles a real female clitoris. In this technique the neoclitoris is placed in the anatomical position of the male suspensory ligament of the penis, therefore, closer to the neovaginal cavity [4] (Fig. 2).

Study design and sample

A prospective survey study was carried out, recruiting 40 oMtF patients during follow-up visits. oMtF patients had to be Italian speaking, and 18 or older. Participants had to have undergone skin flap vaginoplasty at least 6 months earlier and post operative pelvic non-contrast MRI in our Center between 2004 and 2019. MRI images were retrieved, evaluated retrospectively by two radiologists with 20 years' experience in genitourinary imaging.

The two radiologists selected the optimal sagittal, coronal and axial images from which the standardized measurements were then obtained.

The patients who agreed to take part in the study completed an anonymous cognitive questionnaire regarding their demographic, social and medical characteristics (such as current age and age at surgery, partnership status, BMI, diet, alcohol and tobacco consumption, habits and sexual orientation, medical and surgical history, education, job, ethnicity). Informed written consent was obtained for each participant. The patients were informed that their participation in the present study was anonymous and voluntary and that there would be no disadvantages for them if they decided not to participate. The study was approved by the ethical institutional review board (protocol number N.O. 23/2016).

Sexual functioning

Sexual functioning was assessed using the Italian versions of the Female Sexual Function Index (FSFI) and the operated Male to Female Sexual Function Index (oMtFSFI) questionnaires. FSFI is one of the few validated questionnaires for which an Italian version is available and it remains the gold standard for screening and one of the most widely used tools [5]. FSFI is a brief, multidimensional, self-reporting questionnaire consisting of 19 items assessing sexual desire, arousal, lubrication, orgasm and sexual satisfaction over the past 4 weeks. All FSFI domains yield a computed maximum subscale score of 6, resulting in an overall maximum score of 36. Higher scores indicate a better level of functioning. An FSFI total score of 26.55 has been found to be the optimal cut-off for differentiating women with and without sexual dysfunction [6].

oMtFSFI is the first questionnaire to assess sexual function in oMtF patients. It consists of 18 items and assesses 3 domains: Sexual Dissatisfaction, Genital Self Image and Sexual Pain. A preliminary scoring system was developed for each domain as well as for the full scale. An oMtFSFI total score

of ≥ 55 was used for diagnostic classification. Any operated MtF patient who scores 55 or more on the total score should be considered at risk for sexual dysfunction [7].

MRI measurements

MRI is an excellent modality to evaluate the new anatomy after GGAS and it allows an excellent evaluation of the neoclitoris [8]. The spatulated urethral stump, glans remnant and neurovascular bundle are best evaluated on T2-weighted and gadolinium enhanced T1-weighted images [8]. Variants of the surgical techniques can be identified, such as preservation of the dorsal aspect of the tunica albuginea, isolated or with a small amount of cavernous tissue [9]. For a study protocol aimed at studying the reconfigured pelvic anatomy, in our Center, patients undergoing MtF GGAS undergo a non contrast pelvic MRI at 6 weeks after surgery [10]. All MR Scans were acquired with 1.5 T superconductive equipment in sagittal and axial planes using a multichannel phased array coil for parallel imaging (Intera-Achieva, Philips Healthcare, The Netherlands). Turbo spin-echo T2-weighted images were obtained with 3–4 mm thick contiguous sections. When possible, the neovagina and the rectum were distended with gel, or imaging was performed with a vaginal tutor inserted. The patients were instructed to breathe regularly and shallowly to minimize respiratory excursions on the abdominal wall. Respiratory compensation was not necessary, nor use of spasmolytic agents. In the sagittal and in the axial T2-weighted images an excellent depiction of the new female anatomy was obtained. The neoclitoris was identified following the dorsal neurovascular bundle to an ellipsoid mass of variable signal intensity, usually high-to-intermediate. The three axes of the neoclitoris were measured, and the volume was calculated using the ellipsoid formula. The distance between the neoclitoris and the neovagina was also measured. All anatomic measurements were performed using the general electric picture archiving system/centricity system for radiology which has ruler and angle measurement functions scaled to each specific image.

Outcomes

The primary outcome was to correlate neoclitoral location with patients' sexual function. The secondary outcome was to understand whether there was a correlation between neoclitoral size and sexual function.

Statistical analysis

Categorical variables are described by frequencies and percentage while continuous variables by median and interquartile range. The association

between the groups of intervention and other categorical variables was evaluated by Chi square-tests or exact Fisher test. The Wilcoxon–Mann–Whitney test was used to assess the difference in distribution of the continuous variables across the groups of intervention. $P < 0.05$ were considered statistically significant. All analysis was performed using SAS® software, Version 9.4 (SAS Institute Inc., Cary, N.C., USA).

RESULTS

Patient characteristics

Of the 40 patients approached for the enrollment, only 22 completed the questionnaires: 11 patients who had undergone PNT and 11 operated with NCP with a response rate of 55%. Patient characteristics, including basic demographics, surgical, medical and sexual history are summarized in Table 1. Clinical and demographic characteristics were not significantly different between groups, except for the median age of the patients (PNT 42 IQR 30–55 vs NCP 31 IQR 26–40; $p = 0.02$).

Relationship and sexual functioning

Patients who had undergone NCP achieved higher FSFI mean Total Score than those operated with the previous technique (25.81 SD 3.02 vs 18.62 $p = 0.08$). Of the MtFs surveyed, 68.1% reported an FSFI score of less than 26.55, indicating high risk for clinical sexual dysfunction (72.7% PNT vs NCP 63.6%). In the six items of the FSFI there were no statistical differences between the two groups except for desire, which was higher in the NCP group.

According to the oMtFSFI questionnaire, only 22.7% of the participants seem to be sexually dysfunctional (36.4% PNT vs NCP 9.1%) with a total score ≥ 55 .

Patients who had undergone NCP reached mean levels of Sexual Dissatisfaction of 23.36 vs 27.18 of the other group ($p = 0.35$). Mean score of Genital Self Image was 8.09 in NCP and 9.09 in PNT ($p = 0.42$). Both groups expressed mild to moderate levels of Sexual Pain with mean scores of 7.09 for PNT patients and 6.18 for NCP ($p = 0.30$). Data on sexual function are summarized in Table 2.

The stable relationship with a partner influences sexual satisfaction more in the PNT group than patients in the other group. In the PNT group, transgender women were more strictly heterosexual oriented (90.9%) and single (54.5%). However, the NCP group presented a higher rate of heterosexual patients (81.8%) that were in a relationship (45.4%).

MRI measurements

MRI values are summarized in Table 3. The NCP group presented a neo-clitoris mean volume of 1.04 (SD 0.39) cc vs 1.31 (SD 0.78) cc neo-clitoris mean volume of the other group ($p = 0.55$). The mean distance between the neo-clitoris and the neovagina was 4.20 (SD 0.57) cm in the PNT group and 2.55 (SD 0.45) in the NCP group ($p < 0.001$). The cranio-caudal axis of the neoclitoris was 1.12 cm in the PNT group and 0.86 cm in NCP group ($p = 0.04$). The other measurements did not present significant differences between the two groups.

DISCUSSION

For the first time, MRI measurements of neoclitoral size and location and sexual function were reported in oMtF patients. Supporting our hypothesis, the results show that patients who had undergone neo-urethroclitoroplasty according to Petrović, a technique in which the neoclitoris placed closer to the neovaginal cavity, reached greater levels of sexual function than those operated with the previous procedure. However, probably due to the small sample size, this result was not statistically significant. The prevalence of sexual dysfunction detected by the oMtFSFI questionnaire was lower than that reported with the FSFI, probably because the new tool is more sensitive to identifying

Table 1. Characteristics of samples according to genital affirming surgery technique: general demographics and sexual history.

	NCP (n = 11)	PNT (n = 11)	p value
Age (IQR)	31 (26–40)	42 (30–55)	0.02
BMI (IQR)	21.72 (20.57–23.89)	21.60 (21.14–26.22)	0.90
Age at surgery (IQR)	30 (25–39)	35 (26–44)	0.58
Caucasian, N (%)	10 (90.91)	10 (90.91)	1.00
Hormonal therapy, N (%)			
Estrogen	9 (81.82)	7 (63.64)	0.05
Estrogen + ADT	2 (18.18)	0	
Marital status, N (%)			
Single	6 (54.55)	3 (27.27)	0.63
Couple	2 (18.18)	2 (18.18)	
Cohabiting couple	3 (27.27)	5 (45.45)	
Married	0	1 (9.09)	
Educational level, N (%)			
Middle school	3 (27.27)	4 (36.36)	0.42
High school	5 (45.45)	2 (18.18)	
Degree	2 (18.18)	5 (45.45)	
Employment, N (%)			
Unemployed	4 (36.36)	3 (27.27)	1.00
Worker	6 (54.55)	7 (63.64)	
Students	1 (9.09)	1 (9.09)	
Other therapies, N (%)	4 (36.36)	5 (45.45)	1.00
Alcohol consumption, N (%)	5 (45.45)	8 (72.73)	0.39
Smoking, N (%)	3 (27.27)	2 (18.18)	1.00
Sexual orientation, N (%)			
Bisexual	1 (9.09)	1 (9.09)	1.00
Heterosexual	10 (90.91)	9 (81.82)	
Homosexual	0	1 (9.09)	
Correcting surgery, N (%)	0	1 (9.09)	1.00
Feminizing surgery, N (%)			
Mastoplasty	4 (36.36)	4 (36.36)	1.00
Others	0	1 (9.09)	
Lubricants, N (%)	11 (100)	8 (72.73)	0.21
Coital incontinence, N (%)			
Yes	0	1 (9.09)	0.21
Sometimes	3 (27.27)	0	
Urine leakage during sexual intercourse, N (%)			
Sometimes	1 (9.09)	0	1.00
Orgasm, N (%)			
Rarely	4 (36.36)	2 (18.18)	0.70
Often	3 (27.27)	4 (36.36)	
Always	2 (18.18)	1 (9.09)	
Sexual position preferred most, N (%)			
Missionary	7 (63.64)	7 (63.64)	0.39
Female dominant	0	2 (18.18)	
Manual	2 (18.18)	2 (18.18)	
Oral	2 (18.18)	0	

NCP neo-urethroclitoroplasty according to Petrović, PNT Pubic neoclitoris technique, BMI Body Mass Index, ADT androgen deprivation therapy. Chi square or Wilcoxon–Mann–Whitney test except for Fisher exact test where necessary.

Table 2. Responses to validated questionnaires between groups.

	NCP (n = 11)	PNT (n = 11)	p value
FSFI, mean (SD)			
Desire	4.70 (1.33)	2.83 (1.47)	0.01
Arousal	4.69 (0.75)	3.08 (2.09)	0.11
Lubrication	4.09 (1.35)	3.10 (2.32)	0.37
Orgasm	4.47 (1.17)	2.87 (2.33)	0.09
Satisfaction	5.20 (0.77)	3.49 (2.07)	0.07
Pain	2.72 (0.64)	2.25 (1.24)	0.52
Total	25.81 (3.02)	18.62 (9.92)	0.08
oMtFSI, mean (SD)			
Sexual Dissatisfaction	23.36 (6.89)	27.18 (11.16)	0.35
Genital Self Image	8.09 (1.76)	9.09 (2.59)	0.42
Sexual Pain	6.18 (1.72)	7.09 (3.17)	0.30
Total	37.63 (8.28)	43.36 (13.02)	0.23

Results are provided in mean (SD); Wilcoxon–Mann–Whitney test was used for analysis.

FSFI Female Sexual Function Index, oMtFSFI operated Male to Female Sexual Function Index, NCP neo-urethroclitoroplasty according to Petrović, PNT Pubic neoclitoris technique.

Table 3. MRI measurements between groups.

MRI value	NCP (n = 11)	PNT (n = 11)	p value
Latero-lateral distance, cm	1.33 (0.24)	1.25 (0.27)	0.37
Antero-posterior distance, cm	1.66 (0.23)	1.63 (0.46)	0.79
Cranio-caudal distance, cm	0.86 (0.19)	1.12 (0.31)	0.04
Clitoris to vagina distance, cm	2.55 (0.45)	4.20 (0.57)	<0.001
Clitoris volume, cc	1.04 (0.39)	1.31 (0.78)	0.55
Coronal area, cm ²	7.01 (1.63)	6.58 (2.61)	0.79
Sagittal area, cm ²	4.59 (1.33)	6.06 (3.20)	0.47

Results are provided in mean (SD); Wilcoxon–Mann–Whitney test was used for analysis.

sexual dysfunction in these population [7]. However, our mean scores (25.81 SD 3.02 vs 18.62 SD 9.92) are in line with the average FSFI mean score reported in the literature with a range from 18.7 to 23.4 [11]. The age difference favoring the NCP group could be a bias that should be taken into account and that suggests caution in reaching a conclusion from our results. In spite of this, in other cohorts of transgender women reported in the literature, sexual function was negatively associated with years since surgery, but not with age [12, 13]. Moreover, younger patients might have less sexual experience, therefore, older age cannot in itself be considered a negative prognostic factor on sexual function.

Analyzing the oMtFSFI scales, the lowest score was reached in the Sexual Pain Item in both groups. This finding is in accordance with other studies on transgender women who seem to suffer from specific difficulties, especially concerning lubrication and pain [14, 15]. Painful sexual intercourse could be related to scarce lubrication and low neovagina compliance [16]. As the neovagina is not mucosa-coated and, therefore, endogenous secretions are reduced, the problem of lubrication is well known and foreseeable in these patients who should resort to artificial lubrication. To maintain adequate neovagina compliance, patients must perform dilation on a daily basis, regardless of the presence of penetrative sexual intercourse [17, 18]. Therefore, sexual outcome is not only a result of the surgical technique and the clitoral size and location, but also the correct post-operative management of the neovagina.

MRI measurements showed a statistically significant difference in the mean neoclitoris-neovaginal distance in the two groups

with 4.20 (SD 0.57) cm in the PNT group vs 2.55 (SD 0.45) ($p < 0.001$). This result reflects the two different surgical techniques, PNT in which the neoclitoris was fixed in the suprapubic area and NCP that placed the neoclitoris in the anatomical position of the male suspensory ligament of the penis and therefore closer to the neovaginal cavity. As evidenced in studies on AFAB, the closer proximity of the clitoris to the vaginal introitus could increase mechanical stimulation during penetrative intercourse [1, 19]. Other studies have examined distances between clitoris and urethra, reporting that a shorter distance increased a woman's likelihood of experiencing orgasm in intercourse [2]. With the limit of the small sample size, even in oMTFs there seems to be a correlation between shorter neoclitoris-neovagina distance and better sexual function. However, it should be pointed out that comparisons made between MtFs and cisgender women may be subject to a bias related to the different anatomical structures responsible for arousal and orgasm. In MtFs for example, the preservation of the dorsal neuro-vascular bundle of the penis is required to maintain sensitivity. As regard clitoral volume, no significant differences were found according to the surgical technique. In an MRI study on women with genital mutilation, a larger total volume of clitoris and bulbs did not correlate with higher FSFI scores [20]. However, the question of size influencing sexual pleasure is controversial and most of the published studies are questionable in the measuring methods, the use of non-validated questionnaires for sexual function evaluation and the small sample size [1, 19, 21, 22]. Studies on the tactile and vibratory sensitivities of the neoclitoris derived from the glans penis showed that the smaller surface area used for the neoclitoris compared with the unoperated glans penis does not affect sensory thresholds with stimuli [23, 24].

A limitation of this study is the relatively small sample size, however, since it concerns a surgical procedure and a post-operative pelvic MRI that are seldom performed worldwide, perhaps the number of patients is not as small as it might seem. Certainly, one of the strengths of this study is that sexual outcomes were assessed using validated questionnaires, especially the oMtFSFI that is a specific tool developed for operated transgender women. In addition, the population studied was limited and due to the observational nature of this study, a power analysis to calculate the sample size was not performed.

CONCLUSIONS

Sexual function following genital gender affirming surgery is an important outcome for many transgender people, affecting the choice of surgical technique, satisfaction with surgery and quality of life. This study hypothesized a correlation between neoclitoral location and sexual satisfaction. The result will have to be supported by larger multicentric studies, but suggests opting for a GGAS technique that place the clitoral complex closer to the neovagina.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author, [FV], upon reasonable request.

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AUTHOR CONTRIBUTIONS

Conceptualization: FV, MB, and CT; Data curation: FV, MB, GC, FC, and LO; Methodology: FV and CT; Software: GC, GL, and LO; Investigation: FC and GL; Formal analysis: MG and FB; Writing – Original Draft: FV, NP, MB, and MG; Writing—Review & Editing: NP and CT; Supervision: NP, MB, FB, and CT.

COMPETING INTERESTS

The authors declare no competing interests.

ADDITIONAL INFORMATION

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