A Novel Application of Magnetic Resonance Imaging to Surgical Planning of Penile Inversion Vaginoplasty

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Summary: Transfeminine patients undergoing vaginoplasty frequently require reoperation due to dissatisfaction with insufficient vaginal dimensions. The goal of this study was to evaluate the role of preoperative imaging with magnetic resonance imaging (MRI) in establishing appropriate patient expectations and surgical planning for vaginoplasty procedures. In this retrospective review, we identified all patients that received MRI before undergoing penile inversion vaginoplasty by a single surgeon from 2019 to 2020. Our findings suggest that MRI can provide valuable information that can be used to set realistic expectations with patients as well as for operative planning for vaginoplasty procedures. Unlike traditional planning, MRI eliminates subjectivity in its estimate of vaginal depth. Future studies should incorporate a larger patient population and objectively analyze the impact of preoperative imaging on patient satisfaction and other measures of operative outcomes. (Plast Reconstr Surg Glob Open 2021;9:e3733; doi: 10.1097/GOX.0000000000003733; Published online 25 August 2021.)

INTRODUCTION

A growing number of transgender patients are undergoing transition-related procedures annually—a trend that has been affected by changes in sociocultural acceptance, policy, and improved insurance coverage for these procedures.1 Penile inversion vaginoplasty (PIV) is the gold standard approach for producing feminized genitals.1 Patients undergoing PIV report high rates of satisfaction with outward appearance, and the majority of patients undergoing the procedure are able to have vaginal intercourse and achieve orgasm.2

Despite the noteworthy success of PIV, it is not without possible complications. The most common complication is neovaginal stenosis, which occurs when the newly created vaginal canal reduces in size postoperatively.1 In some cases, neovaginal stenosis may make penetrative intercourse painful or impossible. Neovaginal stenosis can result from intraoperative and postoperative challenges. Intraoperatively, a surgeon is limited to penile and scrotal skin for construction of the neovagina, unless the patient is willing to undergo harvesting of additional grafts. Furthermore, neovaginal depth is limited by structures in the abdominopelvic cavity. These structural limitations are not identifiable until the patient is in the operation, making preoperative counseling regarding neovaginal size expectations challenging. Postoperatively, patients are instructed to use a set of increasingly large dilators to create and maintain vaginal width and depth. The process can be both uncomfortable and time intensive, with dilator schedules requiring 15 minutes of dilation several times per day. Inconsistent dilator use can lead to neovaginal stenosis.

Preoperative magnetic resonance imaging (MRI) of the abdominopelvic cavity could provide a useful means of evaluating structural limitations on neovaginal depth, facilitating surgical planning as well as expectation setting with the patient before surgery. Prior research demonstrates that MRI is a useful tool for measuring neovaginal dimensions and for investigating female anatomy in transfeminine patients.3–5 No study to date has investigated the use of preoperative imaging for surgical planning in patients undergoing PIV. In this study, we aim to evaluate the utility of preoperative MRI in patients undergoing PIV for their gender affirming goals.

METHODS

Retrospective Review

All consecutive patients undergoing PIV with the senior author (GDC) at a single center between January 1, 2019 and August 30, 2020 were retrospectively reviewed. Patients were excluded from analysis if they had a previous gender-affirming procedure and were
returning for a revision. Patients were also excluded if they were seeking a zero-depth vaginoplasty, or vulvoplasty, because no vaginal canal is formed, and no depth goals are set. This study was approved by the institutional review board (MHRI 2018-173).

Data Collection
Demographic and comorbidity information (including age, ethnicity, body mass index, and tobacco history) were collected. In patients who were able to obtain a preoperative MRI, the distance from the anal verge to posterior peritoneal reflection (AV-PR) was recorded. Operative and postoperative characteristics, such as skin graft size, complications, and need for revision, were collected.

Preoperative Planning
All patients required approval by a psychiatrist before treatment and a year of exogenous hormone therapy before surgery. Magnetic resonance images were acquired using the 1.5 or 3.0 Tesla magnet. Imaging was performed with the patient in the supine position using a high-resolution body phased pelvic coil. Multiple pulse sequences were obtained without contrast in the sagittal, coronal, and axial planes. Sagittal plane images were used for measuring the AV-PR distance. The anal verge was identified as immediately beyond the inferior margin of the external anal sphincter determined by triangulation of the sphincteric anatomic landmarks in sagittal, coronal, and axial planes (Table 2). The peritoneal reflection was identified as the inferior tip of the seminal vesicles on a midline sagittal T2 image. The distance was measured on a midline sagittal T2 image between these two points. If incidental pathologies were identified on MRI, further evaluation was pursued if clinically indicated.

RESULTS
Patient characteristics are summarized in Table 1. Twenty-one patients underwent pelvic MRI for planning of PIV in the study period. Median patient age at the time of surgery was 30.4 years (IQR 27.1, 46.7). Patients presented with an average body mass index of 27.1 kg/m² (SD 4.9 kg/m²). The majority of patients identified as White (n = 11, 52.4%) or African American (n = 8, 38.1%). Six patients (28.5%) endorsed a history of smoking. No patients were actively smoking within 4 weeks of undergoing PIV.

Table 1. Patient Characteristics

| Preoperative MRI  |
|-------------------|
| (n = 21)          |

| Demographics     |            |
|------------------|------------|
| Age (y) (mean ± SD) | 36.4 (±11.5) |
| Race             |            |
| African American | 8 (38.1%)  |
| White            | 11 (52.4%) |
| Unknown          | 2 (9.5%)   |
| Length of hormone use (y) (mean ± SD) | 7.76 (±6.70) |
| Insuranced type  |            |
| Commercial       | 5 (23.8%)  |
| Medicaid         | 16 (76.2%) |
| Comorbidities    |            |
| BMI (kg/m²) (mean ± SD) | 27.1 (±4.90) |
| CCI (mean ± SD)  | 0.33 (±0.73) |
| Smoking status   |            |
| Never smoker     | 15 (71.4%) |
| Former smoker    | 6 (28.5%)  |
| Current smoker   | 0 (0.0%)   |
| HIV              | 3 (14.2%)  |
| Psychiatric disorder | 8 (38.1%) |

BMI, body mass index; CCI, Charlson comorbidity index; HIV, human immunodeficiency virus.

Table 2. MRI Pelvis Conversion/Transition

| Sequence | Section Thickness (mm) | Intersection Gap (mm) | Field of View (mm) | Orientation       |
|----------|------------------------|-----------------------|--------------------|-------------------|
| Axial T₁ | 5                      | 1                     | 23                 | Crest through     |
| Axial T₁ sat | 5                    | 1                     | 23                 | anus              |
| Coronal T₁ | 5                     | 1                     | 23                 | Pubic symphysis   |
| Coronal T₁ sat | 5                 | 1                     | 23                 | through anus      |
| Sagittal T₁ | 5                     | 1                     | 23                 | Mid trochanter    |
| Sagittal T₁ sat | 5                 | 1                     | 23                 | to mid trochanter |

Use respiratory bellows for very heavy breathers
- No contrast needed
- All imaging MUST include the anus

Fig. 1. On midsagittal imaging, maximum distance from the anal verge to the posterior peritoneal reflection measures 9 cm. A, T1 weighted. B, T2 weighted.
The average AV-PR length was 9.10 cm (SD 1.34). An example of the AV-PR length is shown in Figure 1. Incidental findings were noted in 10 patients, and they underwent further evaluation when necessary. Abnormalities included testicular retraction (n = 2), prostatic hypertrophy (n = 3), thinning of the pelvic wall musculature (n = 1), inguinal hernia (n = 1), annular bulging and spinal stenosis (n =1), sigmoid diverticulosis (n = 1), diffuse heterogenous loss of fatty marrow signal (n = 4), tarlov cyst (n = 1), and utricle cyst (n = 1). The average neovaginal length measured at the patients’ 6-month post-operative visit was 11.0 cm (SD 1.98).

**DISCUSSION**

A novel method for preoperative planning of PIV is presented. Achieving a neovagina of adequate depth is one of the main goals in transfemale sex reassignment surgery and is essential for achieving satisfying sexual intercourse. Extensive preoperative counseling and setting realistic expectations is essential to maximize patient satisfaction. The patient’s own ideas about the changes to her pelvic cavity should be heard and understood; however, patients can have unrealistic expectations about the results of their surgery. Authors have reported patients with gender dysphoria seeking vaginal lengths of up to 24 cm.7

Unlike traditional surgical planning, MRI reduces subjectivity in predicting neovaginal dimensions. MRI provides both the patient and surgeon with objective information regarding neovaginal dimensions that can reasonably be achieved in surgery. In our study, the AV-PR distance offered patients a potential estimate of their neovaginal canal (9.1 cm versus 11.0 cm). Furthermore, the surgeon can visualize abdominopelvic structures that may limit neovaginal depth and plan accordingly. The information gleaned from these images can therefore aid in setting appropriate expectations as well as operative planning.

In addition to predicting neovaginal cavity dimensions, MRI can also aid the surgeon in identifying pathological abnormalities which may contribute to a lengthier and more complex operation and/or postoperative course. For example, weakened pelvic floor muscles, which can be identified on MRI, may complicate postoperative dilator therapy and increase the risk of neovaginal prolapse. Knowledge of this pathology can guide discussions with the patient preoperatively to ensure that she understands what her postoperative dilator therapy will entail. In the present study, incidental findings were noted in almost half of patients and, in several instances, necessitated further evaluation and/or consideration of how a given pathology may impact the PIV operation.

The utility of MRI in this setting is limited by the ability of patients to access it. In several cases, insurance denied the request to perform preoperative imaging because its utility in operative planning has yet to be definitively established. Until insurance consistently covers these preoperative assessments, the broad applicability of this study remains limited. Other avenues for future exploration could be comparing patient reported outcome measures and patient satisfaction between patients that underwent preoperative MRI and those who did not. These studies are currently underway at our institution.

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