Imaging: Examination Technique

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7.1 Introduction

Imaging has been thought to play a minor and questionable role in the evaluation of patients with gender dysphoria. However, several clinical situations require imaging investigations in these patients. Profound modifications of the natal male or female pelvic anatomy occur after sex reassignment surgery (SRS), which are best investigated using MR imaging. Moreover, perforator flap surgery has been introduced in phalloplasty procedures which often requires detailed preoperative investigation of the vessels of the donor and of the acceptor site. Multidetector-row CT (MDCT) angiography allows localization of the perforators in combination with evaluation of the pedicle course. Color Doppler ultrasonography is used to confirm the position of the perforators and is useful to assess the course of the vessels of the neopenis and of the neourethra before prosthesis insertion [1].

Concern is rising regarding breast health in the transgender population, and screening recommendations include mammography and ultrasonography [2]. Breast MR imaging is indicated for investigation of breast augmentation in male to female (MtF) SRS. Urinary fistulas and/or stenoses are the most common complications in female to male (FtM) SRS which are best investigated with voiding urethrography [3, 4].

While the majority of these imaging procedures are performed in transgender patients as in natal men and women, a dedicated MR imaging technique is necessary when looking at the complex postoperative changes after SRS and when multidetector-row CT scanning is performed to image the complex vascular anatomy of the donor and acceptor sites before phalloplasty.

7.2 MRI Investigation

The techniques used for pelvic MR imaging of transsexual patients can be implemented with virtually any MR unit. There is no significant difference in the interpretation of images obtained with any static magnetic field strength. Image quality and signal-to-noise ratio is better, however, with relatively high-field-strength MR units.

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7.2.1 Coil Selection and Patient Preparation

The best results for pelvic imaging are obtained by the use of multichannel phased-array coils for parallel imaging, such as cardiac coils, which provide high-definition images with excellent signal-to-noise ratio. Appropriate patient positioning is important. In FtM transsexuals, the neopenis is dorsiflexed in the midline against the abdominal wall, if possible, and taped in position to reduce organ motion during the examination.

In MtF SRS, the neovagina is normally collapsed, and distinguishing between anterior and posterior walls can be difficult. Such distinction is important for evaluation of the neovaginal length, integrity, and vascularization of the rectal-neovaginal septum. Using gel, the neovagina and the rectum can be distended and easily evaluated.

Several different types of aqueous gels and administration techniques may be used. We use approximately 60 mL of ultrasonographic gel for both neovaginal and rectal distention. The gel is placed in a 60-mL syringe connected with a standard enema tip prepared in advance taking care to minimize the introduction of air, and stored upright with the tip facing upward.

When possible, the MR investigation is performed with a tutor in the neovagina which eases the assessment of the neovaginal dept. All metallic parts of the tutor must be removed before insertion [5–7].

7.2.2 Examination Technique

The patient is examined in at least the sagittal and axial planes. The former is ideal for imaging the neovagina, the rectovaginal septum, and the neoclitoris. In our clinical practice, optimal coverage is provided by 3-mm thin contiguous sections.

Image quality obtained without respiratory compensation can be high enough for the diagnosis if the patient is carefully instructed to breathe regularly and shallowly to minimize respiratory excursions of the abdominal wall. Administration of a spasmolytic agent (Buscopan or glucagon) is recommended to reduce artifacts due to bowel peristalsis, which would degrade image quality.

It is recommended to use turbo spin echo (TSE) pulse sequences which have the advantage of multiple contrast weightings, high-spatial resolution, and high signal-to-noise ratio. Moreover, compared to gradient echo sequences, they are less influenced by susceptibility artifacts.

T2-weighted images allow an excellent delineation of pelvic organs. Fat suppression is not routinely used. T1-weighted images can be combined with spectral fat suppression to differentiate between blood and fat. Good image quality and morphologic detail resolution are obtained with an echo time of about 10 ms and a repetition time of approximately 400–600 ms. Repeated image averaging will average out motion artifacts.

DP-weighted images may be useful in selected cases. They are obtained with an echo time of about 30 ms and repetition time of approximately 4,000 ms.

Contrast-enhanced TSE T1-weighted images with fat suppression are repeated after gadolinium contrast administration early after sex reassignment surgery in order to assess perfusion of the neoclitoris, urethral plaque, and neovaginal wall and to delineate fluid collections. Image subtraction between the non-enhanced and the contrast-enhanced images helps delineation of postoperative fluid collections containing blood when they present with high signal intensity on non-enhanced T1-weighted images.

7.2.3 Contraindications

In general, MR imaging is contraindicated for patients who have electrically, magnetically, or mechanically activated implants, such as cardiac pacemakers, implantable cardiac defibrillators, cochlear implants, neurostimulators, bone-growth stimulators, and implantable drug infusion pumps.

Ferromagnetic or metallic biomedical implants or foreign bodies are also under contraindication due to possible danger of dislodgement or movement. In addition, such objects may be subject to heating and induction of electrical currents.

7.3 MDCT Angiography

MDCT angiography is indicated in patients already scheduled for phalloplasty; it is not advised to image patients who are still uncertain about the type of surgery they will undergo for creation of the neopenis, as it could result in unnecessary radiation exposure.

Previous studies show that MDCT angiography is highly sensitive and specific in visualizing perforators with reduction in surgical time and potential postoperative complications [8]. It can visualize perforators up to 0.3 mm in diameter, provide their precise localization, and depict the course of vascular pedicle. In our institution MDCT angiography is most often performed before free septo-cutaneous anterolateral thigh (ALT) flap phallic reconstruction, which has become a valuable alternative to radial forearm flap with reduced donor site morbidity [9].

7.3.1 Patient Preparation

Patient positioning should replicate the surgical table. Underwear must be removed, as it grossly distorts and compresses the soft tissues producing inaccuracy in the coordinate system. Breath hold instruction should not be underestimated as in our experience some investigations had to be repeated for motion artifacts [10].

7.3.2 CT Scanning

A modern multislice CT scanner is a prerequisite, as is submillimetric slice acquisition. In our department, 100 mL of nonionic iodinated contrast agent (350 mg I/mL) is administered at a rate of 4.5 mL/s followed by a 45-mL saline flush. The scanning is triggered using a bolus tracking system with a ROI set on the aortic lumen at the level of L2–L3 vertebral body. The threshold and delay before starting the scan are intrinsically interconnected and should be adjusted considering the specific scanner in use.

7.3.3 Postprocessing

The volume dataset is examined on the specific workstation available, as most commercial software are adequate. The protocol can be performed by a trained operator in less than 20 min. Surgeons are usually not confident in reviewing a large number of stack images, so the aim of the workflow is to produce a limited number of very informative images.

Five-millimeter axial (Fig. 7.1a), sagittal, and coronal maximum intensity projection (MIP) reconstructions are essential to mark the perforators and depict their course.

Perforator arteries are marked with an arrow at the point where they pierce the fascia, i.e., they pass either through or in between the deep tissues (mostly muscle) to reach the skin and subcutaneous tissue. 3D rendering is then obtained to show the complete course of the pedicle from the perforator to the origin of the pedicle from the main vessels (Fig. 7.1b).

3D surface rendering of the flap is then obtained trimming the volume manually including muscles and cutaneous and subcutaneous tissue to show subcutaneous branching of the perforators (Fig. 7.1c). Manual clipping of the overlaying skin is often necessary as density is superior to subcutaneous fat. Arrows are positioned to mark the precise projection of the perforator's origin on the skin with the use of a Cartesian coordinate system centered on a reference point. In the case of the ALT flap, the system is outlined on the axis of the anterior superior iliac spine and the lateral patella (Fig. 7.1d).

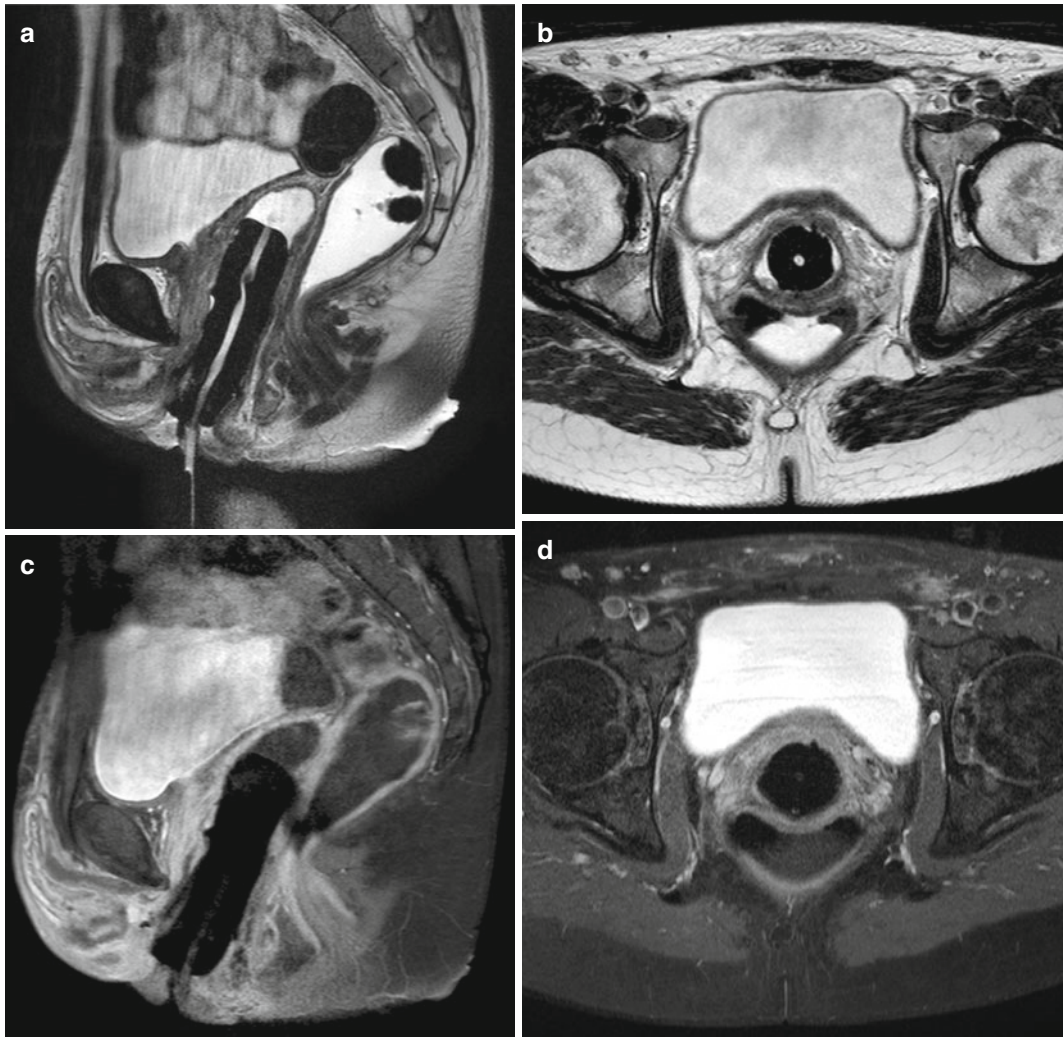

Fig. 7.1 MR imaging after MtF sex reassignment surgery. The neovagina and the rectum are distended with gel. An inflatable tutor is inserted in the neovagina. (**a**, **b**) Sagittal and axial T2-weighted images. (**c**, **d**) Sagittal and axial T1-weighted images with fat suppression obtained after gadolinium contrast administration

7.3.4 Reporting

Standard report includes description of the technique used and a qualitative judgment of the exam quality. Perforators are indexed with the Cartesian coordinate system centered on the reference point. Providing absolute diameter of perforators can be confounding, as diameter is very close to resolution limit. To visually differentiate the surgically relevant ones, perforators with caliber >1 mm can be marked with a different color. Color Doppler ultrasound is used to investigate the flow characteristics of the perforators. Besides evaluation of the vascularity, MDCT angiography allows a precise measure of the thickness of the subcutaneous fat layer, an information which is crucial to estimate the required dimensions of the flap used to manufacture the neopenis.

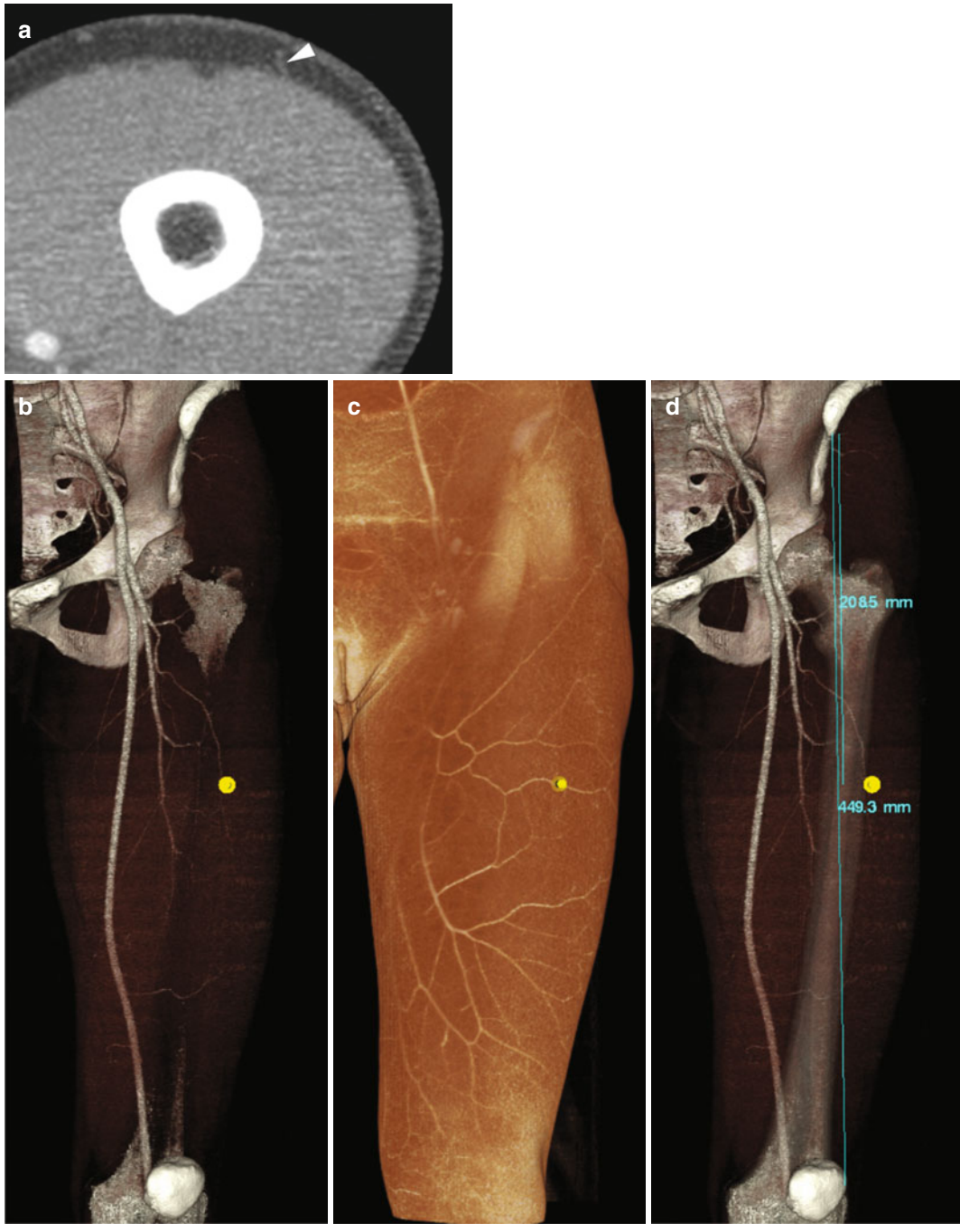

Fig. 7.2 MDCT angiography for preoperative planning of anterolateral thigh (ALT) flap for penile reconstruction. Left thigh. (**a**) Axial 5-mm MIP reconstruction shows a perforator (*arrowhead*) emerging from the vastus lateralis muscle. (**b**) 3D volume rendering (VR) reconstruction obtained to show the complete course of the pedicle. (**c**) 3D surface rendering VR showing subcutaneous branching of the perforators. (**d**) The flap is outlined on the axis of the anterior superior iliac spine and the lateral patella. The yellow mark shows the precise projection of the perforator's origin on the skin.

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