



Metoidioplasty: A Review of Techniques and Focus on Urethral Reconstruction

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Abstract

Metoidioplasty is a gender-affirming genital reconstructive procedure for transmasculine and nonbinary individuals that involves creation of a neophallus from hormonally hypertrophied clitoral tissue. Over the past three decades, the procedure has undergone substantial evolution with respect to surgical technique, aesthetic objectives, functional outcomes and postoperative management. A central driver of this evolution has been refinement of urethral lengthening and construction techniques, which represent the most technically challenging and complication-prone aspects of metoidioplasty and are critical for achieving the ability to void in the standing position.

This review synthesizes contemporary evidence regarding indications, operative approaches with particular focus on methods of urethral reconstruction reported complication profiles and areas in need of further investigation. Although metoidioplasty offers several advantages over phalloplasty, including preservation of erogenous sensation, reduced operative time and faster recovery, it remains limited by achievable neophallus length and inconsistent capacity for penetrative intercourse. Urethral complications such as fistulae and strictures continue to significantly influence patient outcomes and satisfaction, underscoring the importance of ongoing technical innovation and long-term outcome reporting in this field.

Keywords: Urethral Reconstruction; Fistulae; Strictures; Metoidioplasty

Introduction

Gender-affirming surgery plays an essential role in the care of transgender and gender-diverse individuals, reducing gender dysphoria and improving psychosexual well-being. The concept of employing the clitoris for penile substitution in female-to-male transsexuals was first introduced in 1973 by Durfee and Rowland [1]. Over the following decades, surgical refinements led to the development of this approach into what is now known as metoidioplasty, a term derived from the Greek meta (“toward”) and oidion (“male genitalia”), in which a hormonally enlarged clitoris is reconstructed to form a neophallus.

Metoidioplasty is one of the principal options for genital reconstruction. It creates a neophallus by releasing and repositioning hormonally enlarged clitoral tissue, typically after prolonged testosterone therapy that leads to clitoral hypertrophy, increasing erectile tissue length and girth. The procedure emphasizes sensory preservation, genital appearance congruent with gender identity and the capacity for standing micturition.

Key elements of the procedure include maximal straightening and elongation of the clitoris through division of the suspensory clitoral ligaments and the shortened urethral plate; extension of the urethra from the native meatus to the tip of the neophallus to allow voiding in the standing position and reconstruction of the penile shaft skin, scrotum and perineum.

Research interest in metoidioplasty has increased with growing visibility of transgender healthcare needs and the refinement of reconstructive techniques. Following metoidioplasty, the average length of the neophallus generally ranges from 3.8 to 5 cm, though outcomes vary according to individual anatomy, the degree of clitoral growth achieved with testosterone and the specific surgical technique employed. Despite the variations among available methods, most approaches yield only modest changes in overall length. A 2023 study [2], for example, demonstrated that the neophallus measured approximately 0.6 cm longer than the preoperative stretched clitoral length, highlighting the limited but consistent enhancement associated with metoidioplasty. Each surgical technique carries its own profile of aesthetic and functional benefits, making the choice of approach highly dependent on the patient's goals, expectations and broader reconstructive plan.

Surgeons profit by natural enlargement to construct a small phallus while maintaining native sensation and erectile capacity. Metoidioplasty may be chosen over phalloplasty by individuals who prioritize:

- Preservation of genital sensation and sexual function
- A procedure with fewer donor sites
- Shorter recovery times
- A neophallus that matches their aesthetic preferences

Limitations include shorter phallic length commonly 4-8 cm depending on hormonal response and reduced likelihood of penetrative intercourse.

Materials and Methods

Several variations of metoidioplasty have been developed. While differing in operative strategy, they share the principle of releasing the enlarged clitoris from surrounding tissues to increase visible length. Patient-reported satisfaction is generally high, especially concerning tactile and erotic sensation. Standing urination success rates vary widely by technique and surgeon experience. Improvements in body image, quality of life and sexual well-being are consistently reported. Because the neophallus is composed of native erectile tissue, erotic sensation is typically preserved and sexual function often remains valid. Climactic ability is maintained in most cases. However, limited length restricts penetrative capability for many individuals. Studies consistently note decreases in gender dysphoria and enhancements in self-esteem. Access to experienced providers, informed consent processes and postoperative support significantly influence overall well-being.

Complication rates differ significantly across surgical centers and techniques. Commonly discussed complications include: urethral fistulas, urethral strictures, aesthetic dissatisfaction due to limited length or perceived asymmetry.

Phalloplasty remains the dominant option for achieving a larger phallus, including penetrative intercourse and the possibility of penile prosthesis placement. However, metoidioplasty is associated with:

- Lower surgical morbidity
- No major donor-site scarring
- Better preservation of sensation
- Fewer stages, in many cases
- Shorter hospital stays and recovery periods

Choice of procedure is deeply individualized and based on personal goals rather than a strict hierarchy of outcomes. Here below we summarize the main different techniques described by the authors.

Simple Release Metoidioplasty

This low-risk, single-stage approach is limited to clitoral release without urethral reconstruction or vaginectomy. It is particularly suited for patients seeking visible genital masculinization while prioritizing preservation of erogenous sensation.

During the procedure, the suspensory ligaments of the clitoris are divided, allowing increased external projection of the shaft. The clitoral hood and adjacent tissues are reshaped or partially excised to better expose the glans and shaft. No modifications are made to the urethra, vaginal canal or labia and the remaining genital anatomy is left intact, resulting in a more externally prominent clitoris [3].

First Modern Metoidioplasty

A significant milestone in the evolution of metoidioplasty was achieved in 1996, when Dr. JJ Hage described what is widely regarded as the first modern metoidioplasty technique. This approach represented a substantive advancement over earlier clitoral release procedures by integrating clitoral lengthening with urethral reconstruction.

Hage's technique combined division of the suspensory clitoral ligaments with urethral lengthening using vaginal wall flaps, drawing on reconstructive principles established in hypospadias surgery. This innovation enabled the creation of a neourethra extending to the tip of the neophallus, thereby allowing patients to void in the standing position—an outcome not reliably achievable with earlier methods.

In addition, the procedure incorporated vaginectomy and, when indicated, hysterectomy, either as part of the same operative session or as staged procedures. By addressing both genital contour and urinary function, Hage's method established the foundational framework for contemporary metoidioplasty and informed many subsequent refinements in technique [4].

Ring Metoidioplasty

Ring metoidioplasty was developed in Japan by Dr. Ako Takamatsu and is characterized by the exclusive use of local genital tissue to construct both the neophallus and a functional urethra. The technique utilizes the labia minora in combination with an anterior vaginal wall flap to form the neourethra, thereby avoiding the need for extragenital donor sites such as buccal mucosa. As a result, risks associated with oral graft harvest—including postoperative oral pain, xerostomia and donor-site scarring—are eliminated. The procedure does not include vaginectomy, making it an attractive lower-risk option for patients seeking the ability to void while standing while prioritizing preservation of genital sensation and vaginal anatomy.

During surgery, clitoral chordee-restrictive connective tissue limiting projection is released to straighten and lengthen the hormonally enlarged clitoris. A circumferential, ring-shaped flap is fashioned from the inner surfaces of the labia minora, supplemented by a flap from the anterior vaginal wall. These flaps are combined and tubularized over a catheter to create a neourethra extending to the tip of the neophallus, enabling standing urination in the majority of patients.

In contrast to the Belgrade metoidioplasty technique, ring metoidioplasty does not involve vaginectomy. Instead, the vaginal introitus may be reduced while the vaginal canal itself is preserved. This results in a shorter operative time and less extensive tissue dissection but may not be suitable for patients who desire complete vaginal removal.

In Takamatsu's original description, release of the suspensory clitoral ligament was not emphasized. A modified version of the technique, later developed by Dr. Mang Chen and colleagues in the United States, introduced a staged surgical approach to enhance vascular safety. In this modification, maneuvers such as suspensory ligament release, monsplasty and labial fold reduction are intentionally deferred to a second stage, typically performed 4-6 months later. This strategy preserves the anterior vascular pedicle supplying the urethral flap and is intended to reduce complications such as urethral strictures or tissue necrosis.

A suprapubic catheter is routinely placed intraoperatively to divert urine during neourethral healing. Secondary-stage procedures, including scrotoplasty, placement of testicular implants and additional cosmetic refinements such as mons resection, are performed selectively based on patient goals and postoperative healing [5-8].

The Centurion metoidioplasty

Based on currently available information, there is no peer-reviewed scientific publication that formally describes the Centurion metoidioplasty technique in the medical literature. The procedure was first performed in June 2002 by Dr. Peter Raphael, but details of the method appear only in non-indexed surgical summaries and surgeon-produced documents rather than in a published journal article. The earliest known written description is the procedural PDF titled "Female-to-Male Urogenital Reconstruction: The Centurion Procedure" by Tex McFaden, D.O., which outlines Dr. Raphael's technique and notes the first case in 2002. The urethroplasty represents the most technically complex stage of the Centurion phalloplasty, as it creates a continuous neo-urethra extending from the native urethral opening to the tip of the neo-phallus. Its construction relies on the recruitment of multiple well-vascularized local flaps. The amount of available genital tissue directly determines both the number and the length of these flaps and therefore the ultimate length of the urethral extension and the neo-phallus itself.

Once the tissue flaps are elevated, they are wrapped and joined together a pre-placed Foley catheter, which provides as an internal support and temporary stent. The flaps are carefully approximated beginning at the native urethral meatus, creating a single enclosed tubular conduit. As healing progresses, these flaps integrate into one continuous urethral channel capable of directing urine through the newly formed phallic shaft.

To protect the new urethral path and reduce mechanical strain on surrounding repairs including closure of the vaginal space-muscle tissue from both sides of the region is brought together to reinforce the proximal urethral area. This muscular buttressing adds structural support, helps maintain alignment of the neo-urethra and reduces the risk of early disruption of the repair.

Although the overall urethroplasty aims to achieve a functional standing-urination pathway, complications such as stricture and fistula formation may still occur. These typically arise at areas of high tension or along suture lines. Early management often includes temporary dilation, while more significant issues may require revision once tissues have healed sufficiently. Innovations such as muscle-wrap reinforcement around the neo-urethra are being explored to further reduce the incidence of these complications.

Belgrade Technique

In one-stage metoidioplasty, urethroplasty represents the most technically demanding component. In early iterations of the procedure, the urethral plate was preserved, which often resulted in a short and ventrally curved neophallus. To improve functional and aesthetic outcomes and reduce complication rates, several modifications to the urethroplasty technique were subsequently introduced.

In the Belgrade approach, a long anterior vaginal wall flap, typically measuring 5-7.5 cm, is harvested to construct the bulbar urethra. Reinforcement of the urethral suture lines is achieved using an additional flap from the labia minora. The penile segment of the neourethra is formed using a labia minora flap in conjunction with the native urethral plate, which is divided at the level of the original female urethral meatus.

Dissection is performed in a proximal-to-distal direction; however, this technique carries a risk of compromising the vascular supply to the mobilized urethral plate. Long-term follow-up reported by the original authors demonstrated a high overall complication rate of approximately 85%. They further noted that completion of genital reconstruction required an average of 2.6 surgical procedures per patient, underscoring the complexity and morbidity associated with this method [9,10].

Extensive Metoidioplasty

This technique expands upon the Belgrade model by incorporating a deeper dissection of the clitoral crura—the internal erectile structures to achieve greater penile length and enhanced erectile potential. In extensive metoidioplasty, the suspensory ligaments are completely released and the internal erectile tissues are mobilized and advanced anteriorly, exposing anatomical components that are typically left undisturbed in other metoidioplasty variants.

A V-Y incision, approximately 6-7 cm in length, is made just superior to the clitoris and extended inferiorly toward the base of the planned neophallus. Layered dissection is performed with meticulous attention until adequate exposure of the suspensory ligament is achieved, allowing for its complete excision. This stage represents the most critical component of the procedure. Both clitoral crura are then carefully dissected to near-complete detachment from the pubic arch bilaterally. Throughout this process, strict care is taken to preserve adjacent neurovascular structures, typically with the assistance of optical magnification and intraoperative Doppler assessment. Following full release, the crura are approximated in the midline, resulting in additional penile lengthening. The overlying tissues are subsequently closed in layers, maintaining the principles of an optimal V-Y advancement to further enhance projection.

The labia majora are elevated as inferiorly based flaps. Circumferential incision of the clitoris is performed around the labia minora, which are elevated from posterior to anterior. Any residual chordee is identified and completely excised. The inner surfaces of the labia minora are tubularized to form the pendulous urethra; however, in most cases, definitive anastomosis between this neourethra and the native urethra is intentionally deferred to a second stage. Anterior portions of the clitoris and labia minora are excised, while the outer labial wings are fused in the midline to provide ventral coverage of the neophallus. The

inferiorly based labia majora flaps are then advanced in a V-Y configuration to create adequate space for bilateral placement of silicone testicular implants.

A Foley catheter is left in place overnight to ensure urinary drainage and prophylactic antibiotics are continued for 48 hours postoperatively. Although urethroplasty is typically staged in this technique, primary end-to-end anastomosis between the native urethra and the newly constructed urethral segment was performed in the first two cases without reported complications. As part of the postoperative protocol, all patients undergo a penile traction regimen (Penile Enhancement Protocol), initiated approximately six weeks after surgery and continued for a minimum of one year using a device specifically adapted for postoperative anatomy. Continued androgen therapy is strongly recommended, with patients maintained on testosterone enanthate (250 mg every two weeks).

In a cohort of ten patients followed for more than five years, the mean neophallus length achieved was 8.7 cm and 70% of patients reported erectile rigidity sufficient for penetrative intercourse. Despite these encouraging outcomes, extensive metoidioplasty remains technically complex and is associated with an increased risk of urethral complications, including fistula formation and strictures. Long-term outcome data are still limited and continue to evolve [11-13].

Extended Metoidioplasty

Extended Metoidioplasty, first described in the peer-reviewed literature in 2022, represents a contemporary refinement of genital gender-affirming surgery that emphasizes maximal visible length, stable aesthetics and reduced complication rates. Unlike traditional metoidioplasty approaches, this technique intentionally avoids urethral lengthening, instead creating perineal urethrostomy. By preserving the native urethral course and eliminating the need for multi-segment urethral reconstruction, the procedure markedly decreases the risk of postoperative fistulas, strictures and voiding dysfunction. Patients retain full erogenous sensation and spontaneous erectile function but continue to void in a seated position. A defining feature of Extended Metoidioplasty is the extensive release of the clitoris. The suspensory ligaments are carefully dissected under protection of the neurovascular bundle, allowing the clitoral shaft to be advanced and secured to the pubic tubercle to maximize forward projection and enhance visible length. Scrotoplasty is performed through reshaping of the labia majora into a scrotal sac. A distinctive element of this technique is the addition of a suprapubic adipocutaneous flap, which provides natural-appearing scrotal volume without relying on testicular implants. This approach yields a more masculine contour while avoiding the risks associated with prosthetic materials. Additional labial or perineal tissue may be incorporated to broaden and reinforce the base of the neophallus, improving both bulk and overall appearance. Overall, Extended Metoidioplasty is especially suited for individuals who wish to maintain preserved genital sensation and erectile capacity, avoid urethral complications and achieve a natural, proportionate masculine aesthetic without the need for implants or urethral lengthening [14].

TCM (Total Corporal Mobilization) Technique

Total Corporal Mobilization (TCM) is a recent innovation by Dr. Ubirajara Barroso in Brazil that's derived from reconstructive techniques used in cisgender men. Similar in concept to Extensive Metoidioplasty, it involves the complete mobilization of the internal erectile structures. In trans men, TCM repositions the internal portion of the clitoral corpora to enhance visible length and functional potential. The procedure emphasizes sensation preservation and erectile function. When combined with urethral lengthening using oral mucosa, patients may also achieve standing urination. While early outcomes are promising with low complication rates and good functional outcomes, long-term data on durability, patient satisfaction and complication management is very limited and will be critical before widespread adoption can occur (Table 1) [15].

Authors	Glans Cap	Distal Urethra	Bulbar Urethra	Proximal Urethra
Lebovic and Laub, 1989	Preserved as the distal "neoglans"	NA	NA	Native female urethral outlet is maintained
Hage 1996	Preserved as the distal "neoglans"	Anterior vaginal wall flap + vestibular skin flap	Anterior vaginal wall flap + labia minora flap	Anterior vaginal wall flap + labial flap
Takamatsu 2001	The clitoral glans remains	Tubulized labia minora flap	Tubulized labia minora flap +	Anterior vaginal wall flap

	the distal "head"		Anterior vaginal wall flap	
Centurion by Raphael 2002	'Preserved	Labial flaps	Labial flaps	Labial flaps
Belgrade one stage Djordjevic 2009	T-D Technique	Buccal mucosa graft + Labial skin flaps or Urethral plate + Labial skin flaps	Buccal mucosa graft + Labial skin flaps or Urethral plate + Labial skin flaps	Urethral plate + labia minora flap (eventually + buccal mucosa graft)
Cohanzad Extensive Metoidioplasty 2016	Preserved	Tubularized labia minora flaps	Tubularized labia minora flaps	delayed anastomosis
Extended Mediodioplasty 2022	NA	NA	NA	perineal urethrostomy, which moves the urethral opening behind the newly constructed scrotum.
TCM (Total Corpora Mobilization) Barroso 2022	Preserved	Mostly postponed in 2nd stage with buccal mucosa grafts and local flaps	Mostly postponed in 2nd stage with buccal mucosa grafts and local flaps	Mostly postponed in 2nd stage with buccal mucosa grafts and local flaps

Table 1: Reconstructive techniques for neo-urethra.

Conclusion

Metoidioplasty has evolved into a diverse set of surgical techniques that reflect the wide spectrum of anatomical characteristics, functional priorities and personal goals among transgender and nonbinary individuals. Among all variants, preservation of erogenous sensation, reduced surgical morbidity and avoidance of large donor sites remain defining strengths of the procedure when compared with phalloplasty. At the same time, achievable neophallus length and the technical complexity of urethral reconstruction continue to represent its principal limitations. Urethral lengthening and reconstruction emerge as the most critical determinants of both functional success and postoperative morbidity. Techniques incorporating urethral reconstruction offer the possibility of standing micturition but are consistently associated with higher rates of complications, particularly fistulas and strictures, often necessitating secondary or staged procedures. Approaches such as the Belgrade, Centurion, Ring and Extensive metoidioplasty techniques demonstrate the trade-off between functional ambition and surgical risk, underscoring the importance of meticulous tissue handling, preservation of vascular supply and careful patient selection. Conversely, newer techniques that deliberately avoid urethral lengthening, such as Extended Metoidioplasty, highlight a paradigm shift toward prioritizing reliability, sensation preservation and reduced complication rates over standing urination. Emerging strategies including deeper corporal mobilization, staged reconstruction, improved flap design and selective use of grafts reflect ongoing efforts to optimize urethral outcomes while minimizing morbidity. However, heterogeneity in surgical technique, limited cohort sizes and inconsistent outcome reporting continue to impede direct comparison across methods. Long-term data on urinary function, sexual satisfaction, aesthetic outcomes and quality of life remain unclear due to many contemporary techniques, in particular when it comes to newer approaches such as Total Corporal Mobilization. Ultimately, no single metoidioplasty technique can be considered universally superior. Surgical planning must remain highly individualized, grounded in informed shared decision-making that carefully balances patient priorities regarding standing urination, genital sensation, aesthetic goals and tolerance for surgical risk. Future research should focus on standardized reporting of urethral outcomes, longer-term follow-up and multicenter collaboration to refine urethral reconstruction strategies and better define best practices within this evolving field of gender-affirming surgery.

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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Ethical Statement

The project did not meet the definition of human subject research under the purview of the IRB according to federal regulations and therefore, was exempt.

Informed Consent Statement

Informed consent was obtained from the participant involved in this study.

Authors' Contributions

All authors contributed equally to this paper.

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