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GENITOURINARY RECONSTRUCTIVE SURGERY TECHNIQUES: VULVOPLASTY AND VAGINOPLASTY – NARRATIVE REVIEW

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GENITOURINARY RECONSTRUCTIVE SURGERY TECHNIQUES: VULVOPLASTY AND VAGINOPLASTY – NARRATIVE REVIEW

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ABSTRACT

Vulvar, vaginal, and anal tumors are the leading cause of perineal defects requiring soft tissue reconstruction. Nevertheless, genitourinary reconstruction is also necessary to correct congenital malformations as well as defects secondary to serious soft tissue infections. In gender dysphoria patients, vaginoplasty and vulvoplasty are essential to achieve congruent genitalia.

Genitourinary reconstruction is challenging due to the complex functionality, involving excretory and sexual components, and the esthetic appearance of this region. By closing complex defects, these techniques enable adjuvant treatments to be performed earlier, large tumor resections, improvement of clear pathological margin rates, and decrease infectious complications.

The technique of choice depends on location, geometry, depth and size of the defect, quality of surrounding tissues and the surgeon's experience. This review explores surgical techniques giving an overall summary of their methods, complications, and outcomes.

Keywords: genitourinary reconstruction; vaginoplasty; vulvoplasty; flaps; gender-affirming surgery.

Os tumores vulvares, vaginais e anais são a principal causa de defeitos perineais que requerem uma reconstrução dos tecidos moles. Ainda assim, a reconstrução geniturinária é também necessária na correção de malformações congénitas e de defeitos secundários, derivados de infeções graves dos tecidos moles. Em pacientes com disforia de género, a vaginoplastia e a vulvoplastia são essenciais na obtenção de órgãos genitais congruentes.

A reconstrução geniturinária é um desafio devido à complexa funcionalidade, que envolve componentes excretores e sexuais, e à estética desta região. Ao encerrar defeitos complexos, estas técnicas permitem a realização precoce de tratamentos adjuvantes, grandes ressecções tumorais, melhoria das taxas de margem patológica livre e diminuição das complicações infeciosas.

A escolha da técnica ideal depende da localização, geometria, profundidade e tamanho do defeito, da qualidade dos tecidos circundantes e da experiência do cirurgião. Esta revisão explora as técnicas cirúrgicas, resumindo os seus métodos, complicações e resultados.

Palavras-chave: reconstrução geniturinária; vaginoplastia; vulvoplastia; retalhos; cirurgia de reatribuição sexual.

INTRODUCTION

When a congenital or acquired defect occurs in the genitourinary tract, leading to patient's morbidity and mortality, genitourinary reconstructive surgery is desired.[1] In this review, we describe the most frequent surgical techniques to perform a vulvar and vaginal reconstruction.

Vulvoplasty and vaginoplasty aims to uphold wound healing, reduce pelvic dead space, restore pelvic floor, re-establish body image and sexual function[1], while guaranteeing natural feminine aesthetics, moist inner lining, and erogenous sensation.[2] By closing complex defects, these techniques enable adjuvant treatments to be performed earlier, large tumor resections, improvement of clear pathological margin rates, and decrease infectious complications.[3] On account of successful reconstructions, an adequate postoperative surveillance of the remaining tissue can diminish the risk of recurrence or secondary malignant disease.[4] Consequently, they optimize oncologic results.

Genital reconstruction is widely practiced in patients who underwent oncologic resections, present disorders of sexual development (DSD), develop soft tissues infections, in victims of trauma and in gender dysphoria.[1,5]

In the past, acquired defects were left open to heal or primary closed with delayed reconstruction. Nowadays however, defects are immediately reconstructed using flaps.[1] These vulvovaginal surgeries that reconstruct perineal defects avoid functional iatrogenic sequelae such as wound dehiscence, infection, necrosis, and other complications related to primary surgical treatments for local disease control.[6]

Moreover, these techniques play a crucial role within Gender Affirming surgeries, being part of a multidisciplinary approach. Interventions of this matter are highly complex and integrated in World Professional Association for Transgender Health (WPATH) Standards of Care, international guidelines for healthcare community.[1,7]

This review ambition is to explore these surgical techniques, methods, as well as their complications and outcomes.

MATERIALS AND METHODS

A literary review was developed based on bibliographic research within the online database PubMed/MEDLINE. In this research the terms used were: "vaginoplasty", "vulvoplasty", "genitourinary surgery", "Singapore flap", "bilateral gracillis flap", "VRAM flap", "Lotus Petal flap", "bilobed flap", "advancement V-Y flap", "V-Y medial thigh flap", "thigh flap" combined with "perineal", "vulva", "vagina", "vulvar", "vaginal". The considered studies were written in English as well as Portuguese, conducted in humans, published from 2010 to the present day, and available in their complete form. Historical references are also cited where appropriate.

We reviewed and analyzed these articles, firstly by triage through their titles and abstracts, selecting the relevant ones only. Furthermore, evaluating each article with a thorough reading. The ones eliminated were irrelevant. Further relevant bibliographic sources were found through this selection, in a cross-reference method, and included in the review. In total, we ended up including 36 references.

1. VASCULAR ANATOMY

Perineal area is provided with a very rich vascular network based on branches of femoral and internal iliac arteries that anastomose with each other and enables the performance of multiple perforator flaps. Wong et al.[8] utters that the anatomy of the blood supply in the perineal region is the most important underlying basis to an understanding of the numerous flap designs described.

Regarding the arterial supply of the genitourinary region, we highlight three territories from anterior to posterior: the superficial and deep external pudendal artery;[5] the anterior branch of obturator artery; the perineal artery of the internal pudendal artery and the descending branches of the inferior gluteal artery.[8]

A horizontal line passing though clitoris in female divides these three territories. This line is coincident with the second territory supplied by obturator artery.

These arteries send multiple cutaneous perforators to the perineal region organized around the genitourinary and anal orifice.

The perineal artery supplies the labia part of the perineum by terminal branches that anastomose with their counterparts from the opposite side. The other branches of the perineal artery are medial and lateral branches. The medial branch supplies the perianal region, and the lateral branch supplies an area of the posterior surface of the upper thigh. All these branches anastomose with a counterpart from the opposite side and hence form a rich vascular anastomosis around the orifice.
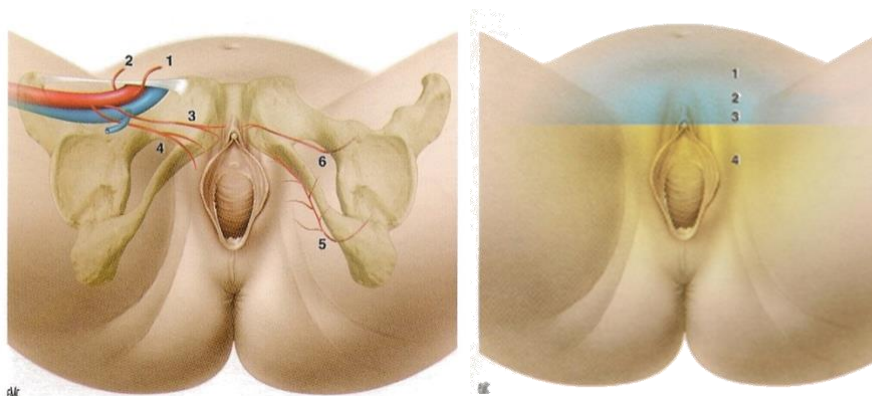

Figure 1 – Perineal vascular anatomy from "Enciclopedia Médico-Quirurgica"

2. ETIOLOGY

Vulvar/vaginal and anal tumors are the leading cause of perineal defects requiring soft tissue reconstruction. Nevertheless, genitourinary reconstruction is also necessary to correct congenital malformations as well as defects secondary to serious soft tissue infections, such as hidradenitis suppurativa and Fournier's gangrene.

Among congenital disorders, vaginal hypoplasia (Mayer-Rokitansky-Kuster-Hauser syndrome), complete androgen insensitivity syndrome, congenital adrenal hyperplasia, bladder exstrophy, and urogenital sinus are some examples.

Traumatic defects of the perineal area are rare but happen. In gender dysphoria patients, vaginoplasty and vulvoplasty are essential to achieve congruent genitalia.

3. CHALLENGES OF GENITOURINARY RECONSTRUCTION

Genitourinary reconstruction is challenging due to the complex functionality, involving excretory and sexual components, and the esthetic appearance of this region. This area gathers a high risk for wound complications due to its large extent, propitiously wet and contaminated openings such as vagina and anus, and easily macerated tissues. Its physiological movements imply stress to suture lines and affect skin grafts stabilization. Moreover, there is every likelihood that pathologies recur, presenting an impaired healing process due to previous scars and irradiation. Furthermore, past incisions and advanced malignancy states diminish availability and choice of flaps and are correlated with malnourishment and debilitation.[8]

In addition, the perineal space and its structures like groin, mons pubis, vagina and urethra confer singular geometries that must be considered tridimensionally, as one single shape, to conclude a refined reconstruction.[9]

4. OBJECTIVES

The most common functional impairments associated with perineal defects are urethral, introital and anal stenosis, diminished sensibility, pain, and lack of sexual pleasure during intercourse and urinary dysfunction. Along with these functional problems, aesthetical concerns also contribute to important psychological discomfort, distortion of the body image and life quality impairment.

The reconstruction of perineal defects has several goals which, according to its priority, can be divided into primary and secondary.[9]

Primarily, a tension free skin coverage with reliable and well vascularized tissues that maintain a central vaginal and urethral introitus must be guaranteed. If necessary, also providing a simultaneous closure of associated wounds, filling possible dead spaces, and reducing risks of complications.[8–10]

Secondarily, restoration of sensation, sexual function, and cosmetic external aesthetics, while enabling rapid healing and minimal donor site morbidity are desired.[9]

RECONSTRUCTIVE METHODS

1. HISTORICAL EVOLUTION

According to our research, at the beginning of the twentieth century, perineal resection of soft tissue and closure of vulvar wounds started by second intention. The scientific knowledge evolved and during decades of 30 and 40, oncologic principals were more defined, starting techniques of en bloc resection of inguinal regions with injury. However, these had low effectivity since an excessive tension and contamination occurred.

It was not until decades of 50 and 60 that the first vulvar reconstruction attempts happened. They progressed from partial or total skin grafts to random flaps, or combination of both.

The end of the decade of 70 marked the moment when McCraw et al pioneered the use of skin flaps based on vascular territories. Afterwards, in 1995, Franco et al. showed the various applications of fasciocutaneous flaps for partial or total vulvar reconstruction[11] and more recently, perforator-based flaps became the main options for genitourinary reconstruction. Yii and Niranjan[12] were the first to describe perforator flaps in perineal area, further developed by Monstrey, Blondeel and Hashimoto.[13]

2. FLAPS

Flaps used in genitourinary reconstruction can be classified through multiple criteria. Nonetheless, we would like to stress three types: Myocutaneous, Fasciocutaneous and Perforator flaps.

Firstly, myocutaneous flaps are used particularly when vagina needs to be reconstructed, dealing with resurfacing, and providing the reliable bulk needed to fill the pelvic cavity after extensive resections. Examples worth mentioning are Rectus Abdominis, Gluteus and Gracillis Muscle, the three of better use for volume defects.[8,10]

Secondly, fasciocutaneous flaps are considered good options for vulvar and vaginal reconstruction and resurfacing of large skin defects. The vascular axis of the thigh medially and posteriorly allows a good viability and sensitivity of the extended flaps.[10,11]

Thirdly, Gentileschi et al.[9] argues perforator flaps, although technically demanding, are preferable in many cases, due to their longer pedicle, better mobility and decrease in donor

site morbidity. It's a muscle sparing technique that has gain popularity, reduces pain and contour deformity.[8,10]

Flaps can also be classified based on their site: local, regional, distant pedicled, and free.[10]

The current research shows disagreements in selection of the preferred approach.[8,9] A thorough preoperative examination and a multidisciplinary approach are essential for the decision-making process of the technique of choice. Evidence states that this is influenced by location and extent of resection,[8] as well as anatomical subunits, overall shape and symmetry, and patients' features, such as skin laxity or previous radiotherapy.[9]

SURGICAL TECHNIQUES

The optimal reconstructive method depends, not only on the defect, but also on patient's characteristics. Cordeiro et al. developed an algorithm, based on the defect type. However, since then, scientific evidence reviewing different techniques and approaches was developed. As an example of the complexity of surgical decision-making process, figure 2 shows us two different algorithms.
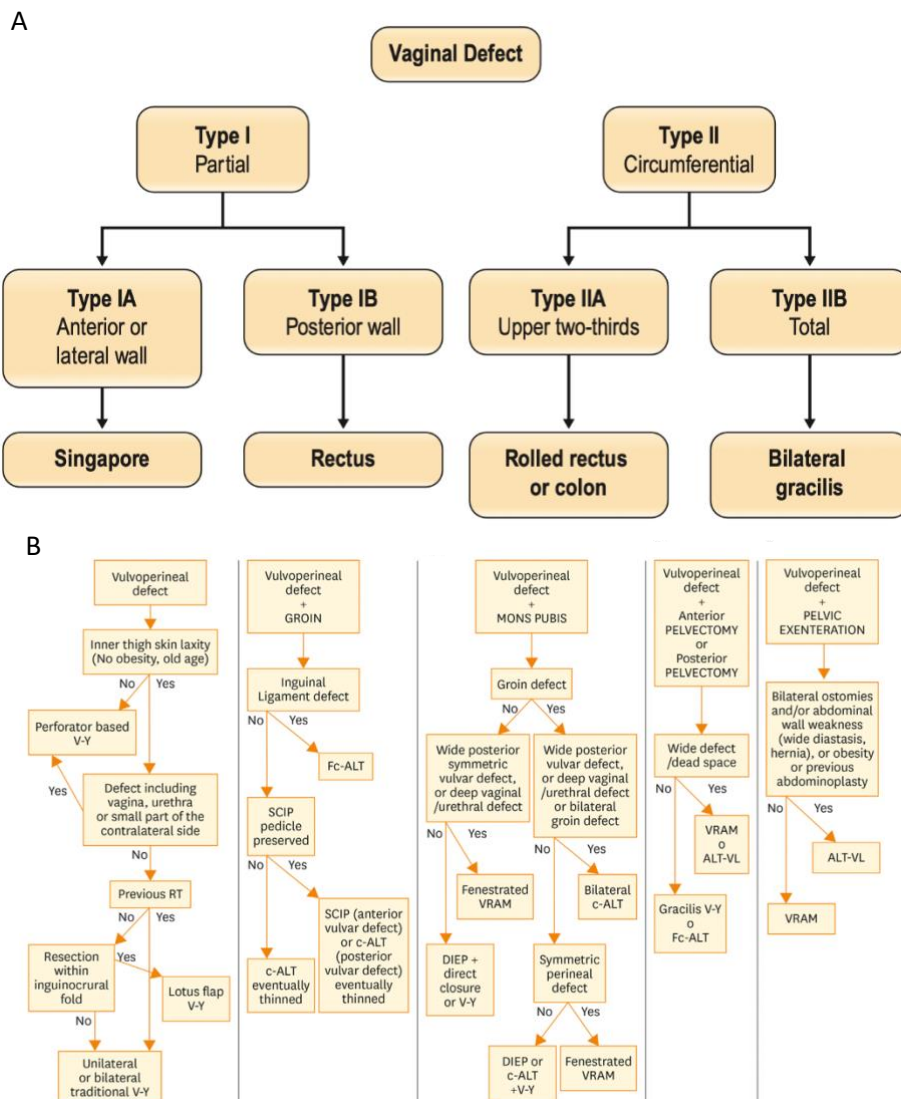

Figure 2 – A: Algorithm for reconstruction of the vagina based on defect type[1]; B: Algorithm for flap selection in vulvoperineal reconstruction after vulvar cancer ablative surgery.[9]

With that being said, we will lay bare several surgical techniques and their features.

A) SINGAPORE FLAP OR PUDENDAL THIGH FLAP

Singapore flap, described by Wee and Joseph in 1989,[14] is a reliable fasciocutaneous thigh flap, with a safe and easy dissection within the same curative surgical field and lithotomy position. It is centred on the groin crease and labiocrural fold, with its base at the posterior introitus. The harvest results in a flap up to 6cm wide by 15cm long, approximately, with a hidden donor-site scar on the genitocrural fold. It is widely used in vaginal reconstruction procedures and surgical repair of rectovaginal fistulae. It also allows reconstruction of medium size defects of the vulva.

Being a well-vascularized flap, due to the posterior labial arteries from internal pudendal artery, enhances healing and maintains a competent innervation through posterior labial branches of pudental nerve and perineal branches of the posterior femoral cutaneous nerve of the thigh.

It can either be used in a unilateral or bilateral way. The estimated remaining vaginal defect, after resection of mass or dissection of stenosis, directly influences that choice.

The procedure consists, firstly, of dissecting and elevating the locoregional flap, beginning at the tip of the flap, incising the skin, subcutaneous tissue and deep fascia, while guaranteeing the integrity of deep surface vessels. For isolated vaginal defects, labia majora can be elevated and dissected from the pubi rami at the level of the periosteum, creating a tunnel. This allows a transposition of the flap, with a 90-degree rotation, avoiding strangulation, and providing enough tissue for resurfacing the vagina.[1,15,16]

Unfortunately, its harvesting site and skin island doesn't avoid lymphatic spread or previously irradiated fields, often being included in vulvectomy procedures. Since this flap replaces vaginal mucosa with skin, it is not totally physiologic and brings hair into the neovagina, which could be cosmetically unpleasant.

B) GRACILLIS MUSCLE FLAP

Gracillis myocutaneous flap is a thigh flap characterized by its limited donor site functional morbidity, as well as effectiveness in contouring vaginal and perineal reconstructions.[17] McGraw et al. firstly described this technique in 1976.

It is a horizontally orientated flap which design allows an easy rotation into the perineum for safe and reliable soft tissue reconstruction. The muscle is considered expendable and able to provide the needed bulk. Its vascular supply is provided by the medial femoral circumflex artery, that enters the muscle 7-10 cm below the pubic tubercule. Its innervation relies on obturator nerve branches.[1]

The location permits a relatively concealed donor scar and a straightforward harvest in a supine position, often bilaterally.[10]

Most common disadvantages identified are its low reliability of skin paddle vascularization and partial/total necrosis rates, from 11-35%.[3]

C) VERTICAL RECTUS ABDOMINIS MYOCUTANEOUS (VRAM) FLAP

Vertical Rectus Abdominis Myocutaneous Flap is a distally based flap. It is harvested above the level of the arcuate line, measuring 10-12cm vertically by 5-8cm horizontally. Shukla and Hughes in 1984 modified the technique into a vertical or oblique skin paddle and inferior pedicle for application in perineal defects,[10,18] yet based on inferior epigastric artery as well.

The described harvesting method consists of Rectus muscle division near the costal cartilage insertion, ligation of superior epigastric vessels, elevation, and dissection from the anterior and posterior rectus sheath to the pubic symphysis, while maintaining inferior epigastric vessels integrity. From then on, the procedure continues either by folding the skin island as a tube, rotating it into the pelvis below the arcuate line and suturing the tubular flap to the introitus or vaginal remnant, creating a neovagina. Or by employing the flap as a patch, suturing skin edges to vaginal mucosa. This distinction depends on the defect type: circumferential or partial circumferential defect, respectively.

Therefore, this surgical technique allows deeper and wider vaginal defects to be corrected besides decreasing postoperative complication.

VRAM is widely used to obliterate pelvic dead space and provide revascularization in tissues that have received radiation therapy without interference with stoma placement.[1,3,19]

VRAM flap is associated a higher rate of donor-site morbidity, namely weakness of abdominal wall.
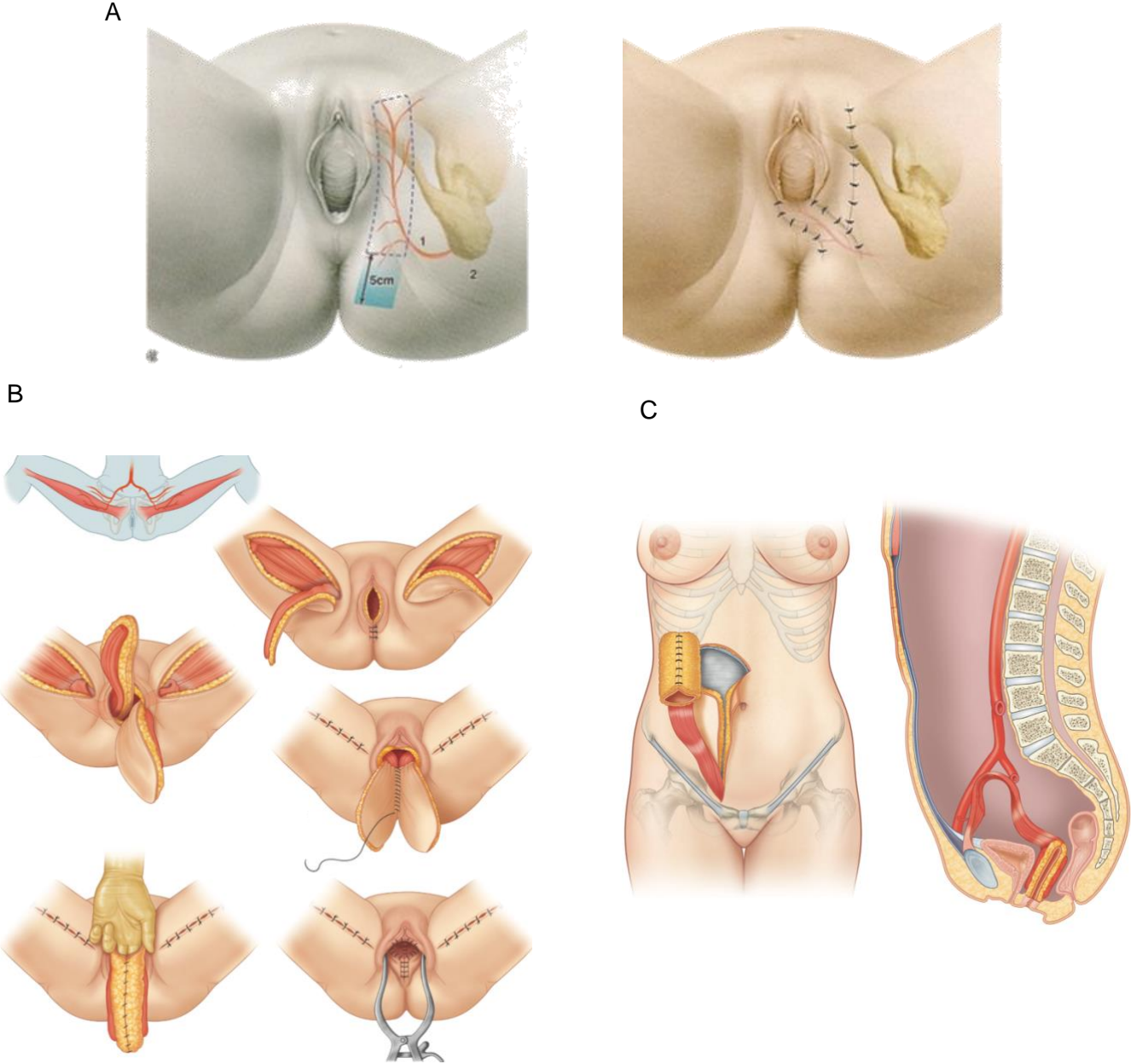
A

B

C

Figure 3 – A: Pudendal Thigh Flap from "Enciclopedia Médico-Quirurgica"; B: Gracillis Flap; C: VRAM flap.[1]

D) DEEP INFERIOR EPIGASTRIC ARTERY (DIEP) FLAP

This technique was first described by Koshima and Soeda in 1989 as an evolution of TRAM flap.[20] DIEP flap is a muscle-sparing perforator flap, designed in a unilateral and vertical shape. It guarantees viable tissue for genital reconstruction, while reducing donor-site morbidity.[21]

With its reliable long and large vascular pedicled, based on deep inferior epigastric artery, allows a robust blood supply adequate for resurfacing defects of the vulva. Consequently, it is another useful technique for extensive vulvar defects, such as pelvic exenteration and extensive radical vulvectomies.[20] Often compared with VRAM flaps, it inflicts minimal damage to abdominal fascia-muscular structures, has lower abdominal wall complication rates and a lower risk of abdominal herniation. This one-stage procedure is also useful in previously irradiated patients.

Post-operatively, a daily vaginal dilation regimen is advised.[21]

E) ANTEROLATERAL THIGH (ALT) FLAP

ALT flaps were firstly described by Song in 1984[22] and first used in perineal reconstruction in 1992.[23] Although having a technically challenging harvest process, they are ideal for lower abdominal, groin and pelvic floor reconstruction.[10,24]

With a pedicle based on perforators from descending branch of the lateral circumflex femoral artery, it confers the ability to extend up to 8 cm above the umbilicus, posterior iliac spine, ipsilateral groin, perineum, anus, contralateral groin, lower abdomen, and ipsilateral trochanter. Cosmetic and functional deficits after tissue transfer are well tolerated.[24]

ALT is capable of a reliable reconstruction of complex perineal defects, when local/regional pedicled flaps are unavailable or suboptimal, multiple ostomies have been created (disabling the use of VRAM flap), inferior epigastric artery pedicle is compromised, or other conditions that make them inadequate to reconstruct the entire defect are present.[25]

F) LOTUS PETAL FLAP

Lotus Petal Flap, described by Yii and Niranjan in 1996,[12] is a versatile fascio-cutaneous flap based on perforating branches of the internal pudendal artery, which are located in a triangle

limited by ischium, anus, and vagina. The median axis of the flap is the gluteal fold. It allows closure of intermediate to large defects of the vulva, through a unilateral or bilateral approach with hidden donor-site scars. Unfortunately, doesn't allow reconstruction of the vagina, being useful for isolated vulvar defects only.

The surgical technique entails the de-epithelization, elevation, and mobilization of the flap from both gluteal and inguinal fold. In bilateral approaches, the second flap is rotated on top of the first and secured to it, moment when the decision to undermine skin is done. Triggered by pudendal nerves near the medial edge of the gluteus maximus muscle, acceptable sensitivity is recovered after 3 to 6 months of harvesting.

This flap relies close to the defect. However, it is outside tumor/lymphatic spread and irradiation area, utilizes preserved perforators during vulvectomy, respects natural anatomic folds and leads to a cosmetic site closure. It can be used in obese patients without modifications.[3,26,27]
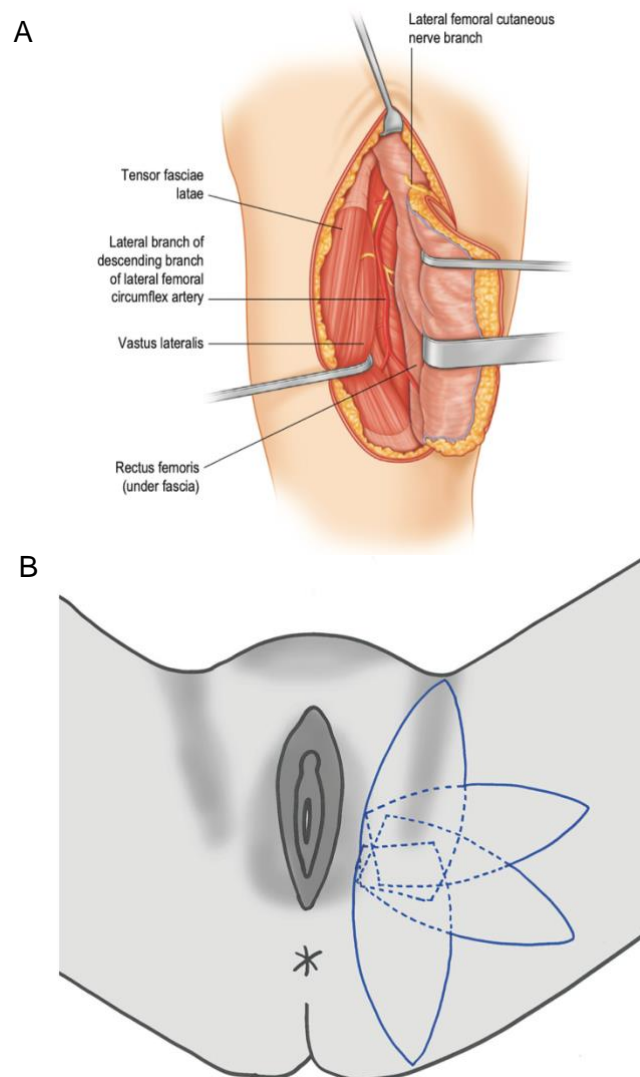

Figure 4 – A: Elevation of anterolateral Thigh Flap;[1] B: Variants of Lotus Petal flap for vulvovaginal reconstruction.[27]

G) PUDENDAL THIGH GLUTEAL FOLD BILOBED FLAP

The fasciocutaneous bilobed flap is an ideal technique both for large vulvar and vaginal defects. It combines two different folds: the anterior lobe – pudendal thigh -, and the posterior lobe – gluteal fold, based on the skin perforating branches of the internal pudendal artery. With this combination of flaps, a tridimensional reconstruction is achieved.

The reconstruction process begins by performing a doppler ultrasound to identify those vascular structures, which will remain connected to the flap as a pedicle and guarantee its blood supply. The axial flap can be completely detached from surrounding tissues, except the referred pedicle. Afterwards, flaps are designed, elevated, and mobilized. The anterior lobe is sutured to the contralateral lobe, permitting the creation of a columnar shape. The posterior lobe is often moved to cover the skin defect of the inguinal lesion.

Consequently, the described method enables more freedom in flap movement without harming tension, with a safe, thin, and cosmetically excellent treatment outcome.[28,29]

H) MODIFIED GLUTEAL FOLD ADVANCEMENT V-Y FLAP

The V-Y advancement flap is a fasciocutaneous flap fashioned in a triangle shape suitable even for covering wide vulvar defects. It has a base ranging from 12 to 16cm, along the edge of the perineal defect, and the apex at the level of the gluteal fold, at the level of the ischiatic tuberosity. Its height can range from 14 to 22cm, depending on tissue laxity.

The technique can be used both as a bilateral or monolateral flap, characterized by its similar skin type, hair, and texture as the donor site. Nonetheless, provides maximal tension in midline and a risk of wound disruption.

The harvesting procedure begins by planning the flap, according to the size and site of post-excisional defect. Afterwards, the skin and sub-skin is incised, mobilized, advanced latero-medially to the vaginal wall, and secured to vulvo-vaginal defective skin, with the least possible tension. Lastly, skin is closed with a suture between the skin of the advancement and mucous membrane, enabling the scarring to fall within the natural cutaneous folds. This technique creates a flattened neovagina with exposure of the vaginal wall.

The preserved pedicle contained in the flap's adipose tissue holds perforators of the internal pudendal artery, as well as posterior cutaneous nerve of thigh and perineal branches of the pudendal nerve.[4,6]
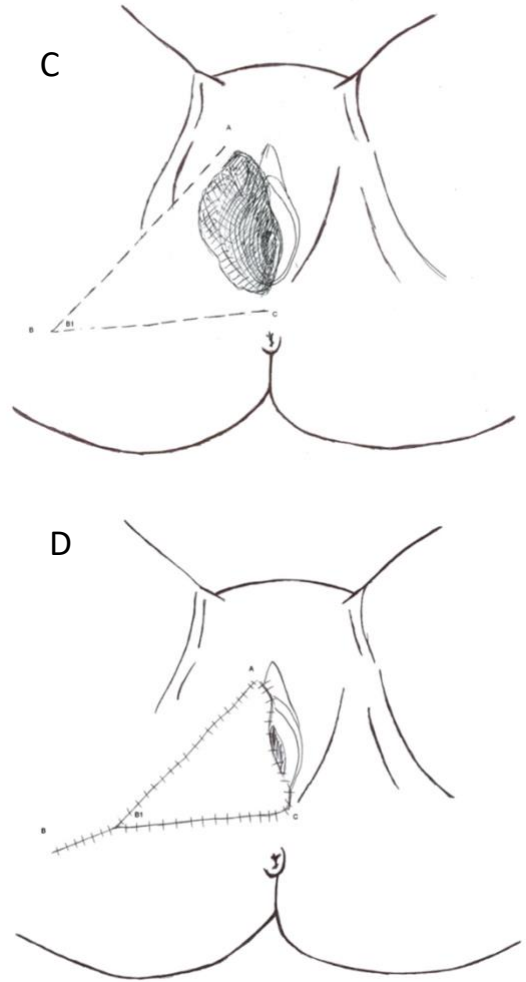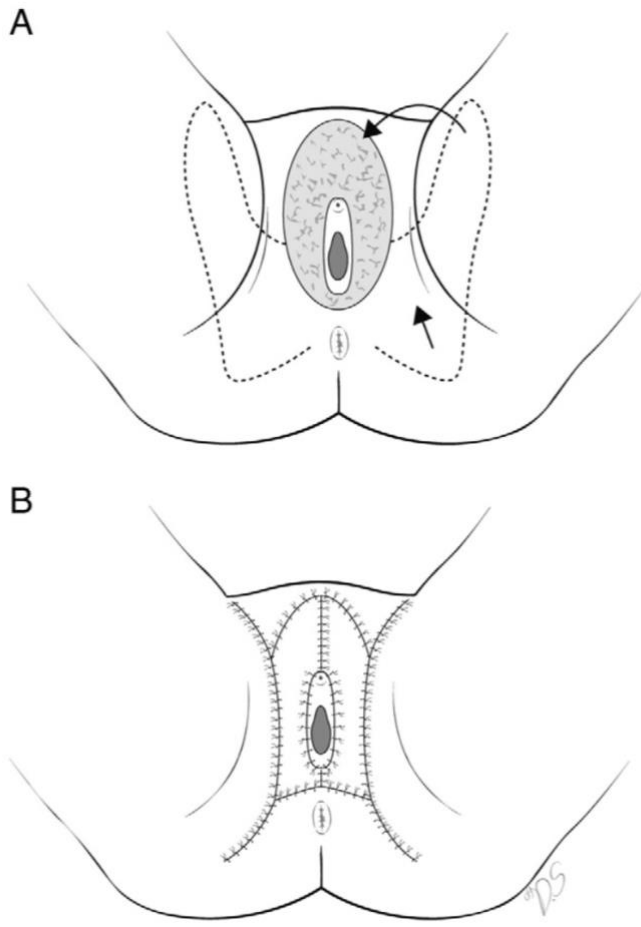
Figure 5 – A, B: Bilateral bilobed pudendal flap, the anterior lobe was rotated to the medial side, and the posterior lobe was advanced like a V-Y advancement flap;[29] C: V-Y flap before advancement; D: V-Y flap after advancement.[6]

I) MEDIAL THIGH FLAP

The V-Y advancement medial thigh flap is an effective one-stage vulvo-perineal process that facilitates the reconstruction of a vulvar defect. It is a triangular shaped flap with its base running along the edge of the perineal defect, and its apex marked within the inner third of the thigh.

The harvesting process is similar to previously described techniques, where dissection, elevation and mobilization occurs. In this specific surgical procedure, the septo-fascio-cutaneous island is advanced in a V-Y fashion to the recipient site, with matching skin color and texture. Despite advancing only a few centimeters and producing a visible scar, guarantees a stable vascular supply and an acceptable sensation through its nerve supply.[30]

J) GLUTEAL THIGH FLAP

The Gluteal Thigh flap lengthens from the inferior border of the piriform muscle in the popliteal region and its pedicle runs parallel to posterior femoral cutaneous nerve.

This transposition flap has its center on the mid-posterior axis of the thigh and its width is directly related to the skin laxity of the donor, and the availability to perform a direct closure of the surface. Nonetheless, the bulkiness makes it unacceptable for isolated vulvar defects.

Moreover, its vascularization is granted by the descending perforator branch of the inferior gluteal artery. Due to its wide surface, it can cover complex deep pelvic and perineal defects, and irradiated wounds. However, its size leads to disadvantages, such as discomfort and paresthesia. Scars are also located in a more exposed area of the body, being too long and visible.[30]
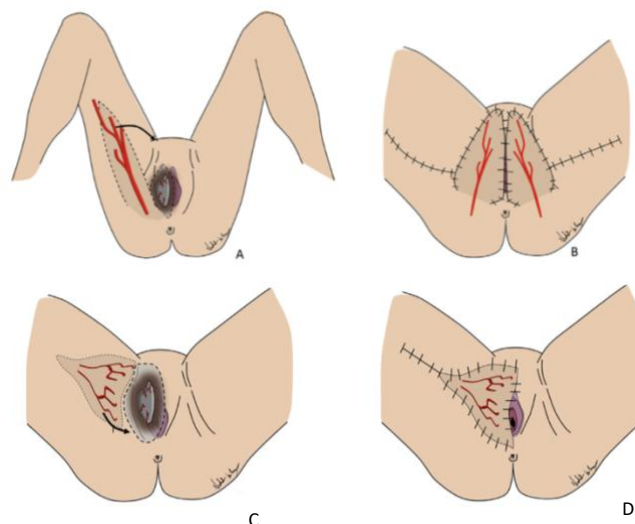

Figure 6 – A, B: Gluteal thigh flap; C, D: Medial thigh flap.[30]

1. GENDER AFFIRMING SURGERY

The techniques described are useful in Gender Dysphoria patients, transitioning from male to female, and in Disorders of Sexual Development. Hence, there are two major procedures:

A) PENOSCROTAL SKIN FLAP

Li et al.[7] states that Penile Inversion Vaginoplasty is the most common vaginoplasty technique utilized today. It guarantees aesthetic and functional vagina and external genitalia.

With this procedure, labia majora are formed from scrotal skin, labia minora from lateral neovaginal tissue and clitoris from reduced dorsal glans, perfused by dorsal penile artery and innervated by dorsal penile nerve. Preoperative patient routine requires a bowel preparation.

Surgery starts by identifying and marking perineal flap and the location of vaginal introitus, then a bilateral orchiectomy is performed, followed by a dissection of the vaginal canal. A disassemble of phallus is essential: dissection and preservation of penile skin, resection of bulbospongiosus muscles, separation of the urethra from corpora, and partial removal of ventral corporal bodies sparing neurovascular bundle and a portion of the glans. The distal excess urethra is discarded and the neoclitoris can finally be created. Afterwards, the neoclitoris is loosely affixed to pubic symphisis to prevent migration. Penile skin is inverted and advanced into the neovagina, creating labia majora naturally. When penile skin is not enough, it is sutured together with scrotal grafts and inverted in the same fashion. The labia minora and clitoral hood are constructed and a vaginal packing, which can only be removed after 5-7 days, is placed.

This complex technique enables the creation of the ideal neovagina a female appearance, a sensate neoclitoris and a vaginal cavity satisfactory for a patient's needs.[7,31]

B) DISTAL SIGMOID COLON OR ILEUM

Distal Sigmoid Colon or Ileum harvesting is a technique used when there is a shortage of penoscrotal skin or failure of previous inverted penoscrotal vaginoplasty. It requires a bowel preparation.

Patients are put under general anesthesia, in a lithotomy position and the laparoscopic harvest begins. A segment of distal sigmoid is isolated alongside its vascular bed - branches of inferior mesenteric artery. The colon is reanastomosed and the colonic segment has its layers closed. The proximal end is fixed to the sacral promontory, preventing neovaginal prolapse, and the distal end is sutured to perineal skin of the new vaginal introitus. At last, the neovagina requires molding with a loose Vaseline vaginal pack for 48 hours. The ileum harvesting process is similar.

Evidence reports several advantages and disadvantages to each technique.

Firstly, sigmoid colon is closest to the perineum, easily pulled and has satisfactory diameter without need for reconfiguration. However, risk of neovaginal diversion colitis and complaints of discharge and malodor have been reported.

Secondly, ileum has a more fragile mucosa, which can lead to mild bleeding after intercourse, excessive mucus production, and vaginal stenosis at a more frequent rate.[32,33]

Wauter et al.[33] states that, to date, it is not known if one method of intestinal vaginoplasty is superior. Nonetheless, currently most centers do not consider ileum vaginoplasty as the first surgical choice. This has to do with the fact that it is highly associated with donor site morbidity: dehiscence risk of intestinal anastomosis and adherences at a late stage. It is however used for revision procedures.

Figure 7 – Surgical procedure where a penile inversion vaginoplasty is performed.

COMPLICATIONS

Due to the complexity of genitourinary reconstructive surgeries, relying on several factors such as type of procedure and flap, patients often present complications. These can be divided by moment of manifestation, either as immediate (within 30 days of surgery) or long-term (after 30 days and within 6 months of surgery).[34]

Intraoperative complications can result in urethral, bladder, ureteral and rectal injury, bleeding, infection, hematoma, graft rejection or flap necrosis. Specific behaviors such as placement of drains during surgery are used for prevention of hematoma formation. However, this increases the risk of infections and delayed wound healing. Nonetheless, broad-spectrum antibiotics administration reduces risk of infection in immediate post-operative period.

Delayed complications can be directly related with the type of surgery performed. When using skin grafts, its harvest can result in visible external scars, symptomatic vaginal hair growth in the neovagina, low lubrification and stenosis.

Additionally, in intestinal vaginoplasties risks include postoperative ileus, peritonitis, anastomotic leak or obstruction, intraabdominal adhesions, mucosal prolapse, rectovaginal fistula, excessive malodorous mucosal discharge, polyps, malignancies, diversion colitis and development of inflammatory bowel disease.

Furthermore, pelvic floor disorders like prolapse, voiding dysfunction, urinary urgency, fistulas, genital pain, wound dehiscence, abscesses, and hemorrhages are reported.

Long-term follow-up and management of complications include multiple procedures. A mild introital stenosis can required estrogen cream, lidocaine gel, lubricants, or pelvic floor physical therapy. If at risk of obstruction, management can go from intermitted dilation regimens to releasing incisions, interposition grafts with stenting and dilation or revision vaginoplasty. Discussions with patients must ponder the risks and benefits of interventions as stated, in order to operate as faithfully as possible to their needs.

A non-menstrual neovaginal bleeding should be thoroughly evaluated and treated. If related with mucosal trauma, pelvic rest, review of dilator technique, lubricant and surgical intervention might be considered.

Post-operative abscesses, infections, seromas or hematomas, dilation injuries or neovaginal malignancies may lead to neovaginal fistulas – rectovaginal, vesicovaginal, urethrovaginal, ureterovaginal. These require a fistulectomy with primary tension-free closure and urinary or fecal diversion may improve healing.

Urinary incontinence should be treated with anticholinergic, b3-adrenoreceptor agonist medications, bladder botulinum toxin injections, sacral neuromodulation, physical therapy, or urethral sling.[35,36]

Table 1 sums up the complications stated above, as well as management strategies on how to avoid the complication, or how to treat and follow its evolution.

	Complication	Management
Early	Hematoma formation	Avoided by drain placement; drainage
	Infections	Avoided by broad-spectrum antibiotics in preoperative period
Delayed	Introital stenosis	Estrogen Cream, Lidocaine Gel, Lubricants, Pelvic Floor Therapy, Catheter dilation, Urethroplasty, Surgical revision
	Vaginal stenosis	Intermitted dilation, releasing incisions, interposition grafts with stenting and dilation, revision vaginoplasty
	Bleeding	Pelvic rest, review of dilator technique, lubricant and surgical intervention
	Diversion colitis • Malodor • Excessive discharge • Bleeding • Pain	Vaginal enemas of sodium butyrate and aminosalicylic suppositories
	Inflammatory Bowel Disease • Vaginal/rectal bleeding • Vaginal discharge • Vaginal/abdominal pain	Hydrocortisone and Mesalamine suppositories, systemical medical therapies and neovagectomy
	Idiopathic discharge	Frequent irrigation
	Prolapse	Vaginal suspension to sacrospinous ligament or sacrocolpopexy
	HPV infection	Avoided by HPV infection, contraception using condoms and IST screening, Biopsy of suspected lesions
	Fistula	Surgical repair

Table 1 - Common complications and management strategies

CONCLUSION

Genitourinary reconstructive surgeries are extremely complex and require high-end techniques to offer patients a functionally and esthetically pleasing genitalia. DSD, gender dysphoria, trauma, malignant tumors, and infections are the most common etiologies and the decision on how to intervene is based on a multidisciplinary approach. Moreover, gathering patients' consent and guaranteeing comprehension of the procedure, of the post-operative care and follow-up needed is an essential pre-operative routine.[35] In the present days, the majority of perineal defects are reconstructed based on perforator flaps, since they usually present an adequate thickness, a reliable blood supply, matching local skin characteristics and low donor-area morbidity.

Myocutaneous flaps still have a role in genitourinary reconstruction being suitable for very large and complex defects.

The choice depends on location, geometry, depth and size of the defect, quality of surrounding tissues and the surgeon's experience.

There are high rates of patient overall satisfaction with surgery, favorable function, and cosmetic outcomes[34] which only reinforces the importance of genitourinary reconstruction surgeries providing a good quality of life.

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