

A Systematic Review on vulvovaginal/perineal reconstruction after oncologic resection

Background

Cancer of the vulva has not been a frequently occurring condition as it has been reported to possess just up to 5% share of cancers occurring in the genital tract of women (Roh et al., 2021). It was shown to occur mostly in the later years of the life of women and also proven to be best resolved by the surgical removal of the vulva when detected early (Windhofer et al., 2012; Roh et al., 2021; Stephanie et al., 2019). According to Salgado et al., the procedure of an oncologic surgery targeted at alleviating or curing vulvo-perineal or other related malignancies could sometimes be accompanied by resulting defects due to extirpation. These defects call for a process termed “reconstruction”, another surgical procedure aimed at supporting the process of wound healing and also prevent further organ dysfunction. Besides from this purpose, reconstruction also helps to strengthen the mental view of oneself as a woman (Salgado et al., 2011). The performance of a reconstructive surgery should be preceded by a proper evaluation of the prospective procedure and the risks and benefits involved, in addition to patient condition and its requirements (Westbom and Talbot, 2019).

The choice of reconstructive technique to be used is based on the outcome desired to be achieved which may include the reduction of hospital stay, convenience, aid recovery, and prevent complications (Hand et al., 2018).

The aesthetic outcome of reconstructive surgeries in the vulvovaginal and perineal regions are of significant importance to the patients and should be paid astute attention. Besides this, the occurrence of complications should be as minimal as possible to improve patient quality of life. Hence, the need to evaluate the outcome of diverse techniques of conducting a reconstructive procedure in a patient previously diagnosed with malignancies in those regions.

This study is therefore aimed at carrying out a systematic review on selected relevant studies in order to evaluate and compare the outcomes of diverse forms of flaps in reconstructive surgeries for the vulvovaginal or perineal regions.

Materials and Methods

The population of this study included patients affected by defects arising from previously conducted oncologic surgery due to vulvar and/or perineal malignancies undergoing reconstruction. These patients have undergone reconstructive surgery due to the defects.



2.1. Data sources

This systematic literature review was performed in accordance with the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement for developing study protocols and reporting systematic reviews.

The online literature search was performed on the PubMed, Google scholar, Cochrane, and Scopus databases, starting in January 2005 and last updated on 9th of March, 2022 by an experienced librarian. Key terms included 'vulvo-perineal reconstruction', or 'vulvo-perineal defect', or 'vulvar flap', or 'perineal flap', or 'perineal reconstruction' and were tailored for every database.

Inclusion criteria

Articles were included if they

- had information on the reconstruction of vulvo-vaginal, vulvar, or vulvo-perineal region,
- were clinical trials with 5 or more patients, and
- were published between 01/01/2005 and 09/03/2022.

Exclusion criteria

References were excluded

- when they did not report on human subjects, when the sample size was less than 10,
- when the report was not written in English,
- when the report was secondary research,
- when a specific reconstruction of the vulvo-perineal region was not the focus of the study, or
- when the full-text version was not published.

Three independent reviewers screened the titles and abstracts of all identified publications. The full-text versions of the selected articles were retrieved and analyzed again independently by two of the authors. Consensus on which full version articles would be included was reached by discussion. Lastly, the reference list of the included articles was screened for additional suitable papers and subjected to a similar systematic selection process as the one for the originally included set of publications.

2.2. Study selection

All terms were searched on google scholar and only relevant literature works from the years stated (2005-2022) were reviewed. References and related articles were searched to identify other potentially relevant studies. The search for the keywords on google scholar yielded a total of 16,200 results for the search for 'perineal flap', and 10,200 results for 'vulvar flap'. 523 for 'vulvoperineal defect', and 133 for 'vulvo-



perineal reconstruction'. Studies were selected according to their alignment with the inclusion and exclusion criteria.

2.3. Terminology and classification of defects

Reconstruction - Defects occur due to surgeries carried out to solve conditions caused by malignancies in the vulvovaginal and perineal regions, depriving the patient of carrying out previously 'normal' activities (Roh et al., 2021; Elia et al., 2021). This is an issue as the aesthetic appeal of those regions is of significant relevance (Coltro et al., 2017). Hence, reconstruction is the surgical procedure to restore organ function, increase aesthetic appeal, and aid wound healing (Westbom and Talbot, 2019; Harries et al., 2021; Windhofer et al., 2012).

A "flap" - This refers to a piece of tissue removed from a site (called the donor site) of the body and transferred and grafted into another (called the recipient site, mostly defected) while maintaining its vascularisation (Di Donato et al., 2017).

The kind of flap to be used in reconstructive surgery is determined by the degree of defect suffered by the patient (Coltro et al., 2017). To restore the structural aesthetics of those parts of the body, primary closure is usually conducted or flaps done for a higher degree of defects (Luna-Merlos et al., 2017). Flaps are preferred to primary closure during reconstruction as they can aid tissue repairs and alleviate wound dehiscence (Coltro et al., 2017; Devulapalli et al., 2016).

Cordeiro classified defects into partial and complete types, with each having two subtypes as shown below:

Type Ia - partial defects of the lateral and/or anterior vaginal wall

Type Ib - partial defects of the posterior vaginal wall

Type IIa - complete defects of the upper two-thirds of the vagina

Type IIb - total vaginal resection

(Balogun, 2022).

For type I, subtype IA refers to those which arise from resection procedures done in cases of vaginal or urinary tract malignancies, affecting the anterior and/or lateral vaginal walls. Subtype IB refers to the defect associated with the resection therapy for colorectal carcinomas and usually affects the posterior walls of the vagina. For Type II, subtype IIA results from the procedures dealing with cancers associated with the cervix or uterine and the defects affect a larger part of the vagina (up to two-thirds). Finally, subtype IIB affects the whole vagina (Salgado et al., 2011).



2.4. Data extraction

The following parameters were used for comparison of postoperative complications among the selected studies: Wound dehiscence, Hernia, Necrosis, flap loss, Fistula, Stenosis, re-operation, Tumour recurrence, Infections, and death. These conditions were classified as complimentary based on the 'Accordion Severity Grading system of Surgical Complications' (Salgado et al., 2011).

2.5. Data synthesis

From the studies obtained for review, the following types of reconstruction procedures have been identified:

Buried Desepidermised fasciocutaneous V-Y advancement flap- BDF V-Y Adv.

Lotus Petal Flap- LPF

V-Y advancement flap

Partial myocutaneous gluteal flap- PMGF

Anterolateral Thigh Flap-ALT/ATF

Gracilis Flap- GF

Keystone Flap- KF

Internal Pudental Perforator Artery-based Gull Wing Flap- IPPAGWF

Vertical Rectus Abdominis Myocutaneous- VRAM

V-Y gracilis myocutaneous flaps- V-Y GMF

Deep inferior epigastric artery perforator flap- DIEP

Limberg flaps- LF

Superficial circumflex iliac artery perforator flap- SCIP

V-Y Fasciocutaneous flap- V-Y F

Bilateral gracilis myocutaneous flap- BGM

Unilateral gracilis myocutaneous flap- UGM

Bilateral VRAM flap- BVRAM

Unilateral VRAM flap- UVRAM

Omental flap- OF

Bilateral fasciocutaneous flap- BFF

Unilateral fasciocutaneous flap- UFF



RESULTS AND DISCUSSION

Studies included in the review were those studies carried out between January 2005 and March 2022 which met all inclusion criteria and were proven to be relevant to this research. Table 1 below gives a summary of all reviewed studies.

Table 1: Individual features of studies selected for the review of vulvo-vaginal and perineal reconstructive surgeries

Author	Argenta et al	Bell et al	Block et al	Bodin et al	Bowers et al	Chasapi et al	Coelho et al	Coltro et al
Year	2013	2005	2019	2012	2018	2017	2019	2017
Category	LPF	RAM	BGM, UGM, OF, VRAM, BFF, UFF	Modified LPF	PMG flap	PTO flap	BPGMF	IPAP
Study	Retro	Pro	Retro		Retro	Retro	Retro	Pro
Number of patients	59	31	43	5	48	14	25	73
Average age	59	55	56	72	68	67.7	62	60



Complications	8 (14%)	16	28 (65%)	3	40	2	12(48%)	35(48%)
Dehiscence			21 (62%)	1	12 (26%)	1	6 (24%)	27(37%)
Hernia					5	1		
Necrosis		3						3 (4%)
Flap loss	7		2 (6%)					
Fistula		1	4 (12%)					
Stenosis		2	2 (6%)					
Infections			2 (6%)	2			4 (16%)	7 (10%)
Reop	4				6		11 (44%)	14
Death		1					10(40%)	27



Tumour recurrence							2 (8%)	6
-------------------	--	--	--	--	--	--	--------	---

Author	Buda et al	Elia et al	Gentileschi	Hage et al	Han et al	Hand et al	Harries et al	Hellingsa et al
Year	2017	2021	2016	2018	2015	2018	2021	2016
Category	V-Y adv. Flap,	Pedicled perforator flap	V-Y, VRAM, ALT, GMF, SCIP, LPF	PB and SB	IPPAGWF	V-Y FC	VRAM	LPF
Study	Retro	Retro	Retro	Retro	Retro	Retro	Retro	Retro
Number of patients	128	33	80	9	9	27	178	28
Average	68.8	60.1	68	78.2	71	69	67	62.1



e age								
Complications	27(21%)	15	18	4	1			13
Dehiscence	11	10	14	1			46 (25.9%)	
Hernia							62(34.8%)	1
Necrosi s	8	4			1			5
Flap loss							4 (2.3%)	
Fistula								
Stenosi s								
Infectio ns	4	3	4	1		4	72(40.4%)	2



Reop			7			1	18 (10.1%)	9
Death				3				
Tumour recurrence								

Author	Hellinga et al	Hellinga et al	Horch et al	Huang et al	Lange, Hage, and Beurden	Lazzaro et al	Nelson and Butler
Year	2018	2021	2020	2015	2017	2010	2009
Category	LPF	Unilateral and bilateral LPF	vascularly pedicled tpVRAM flap, RAM flap	EPAP, MCFAP, DFAP, IPAP	V-Y adv.	V-Y adv, FC	Thigh flap & VRAM
Study	Retro	Retro	Retro	Retro	Pro		Pro
Number of patients	93	11	142	16	75	8	19 & 114



Average age (years)	65.4	56.6		55.7	72	67	63 & 58
Complications	65 (69.9%)	12	9	14	28%	1	84% & 72%
Dehiscence	14%		5 (3.5%)		12		1 & 16
Hernia							0 & 12
Necrosis					12	1	
Flap Loss	29.4%				1		4 & 7
Fistula							
Stenosis							
Infections				2	5		9 & 21
Reop							



Death					16		
Tumour recurrence				3			

Author	Ozkaya et al	Panicci et al	Peiretti et al	Singh et al	Windhofer et al	Zeng et al	Zhang et al
Year	2017	2014	2019	2016	2011	2011	2015
Category	BDFC V-Y Adv. flap	LPF	KPIF	GF, VRAM	FCI	Pedicled ALT flap	ALT, PTF, DIEP, and TRAM
Study	Retro	Retro	Pro	Retro		Retro	Retro
Number of patients	9	29	5	40	15	11	36
Average age		70	69	56.8	56	52	49.7
Complication	0		1	21		6	11 (30.56%)



s				(52.5%)			
Dehiscence		3 (10.3%)	1	10 (2.5%)	1	1	5 (13.89%)
Hernia							
Necrosis					1	1	5 (13.89%)
Flap loss				1 (2.5%)	1		
Fistula							
Stenosis		2 (6.9%)					
Infections				4 (10%)			
Reop							
Death							
Tumour recurrence					1		

Abbreviations: **BDF V-Y Adv.** - Buried Desepidermised fasciocutaneous V-Y advancement flap, **LPF** - Lotus Petal Flap, **V=Y Adv.** - V-



Y advancement flap, **PMGF** - Partial myocutaneous gluteal flap, **ALT/ATF** - Anterolateral Thigh Flap, **GF** - Gracilis Flap, **KF** - Keystone Flap, **IPPAGWF** - Internal Pudendal Perforator Artery-based Gull Wing Flap, **VRAM** - Vertical Rectus Abdominis Myocutaneous, **V-Y GMF** - V-Y gracilis myocutaneous flaps, **DIEP** - Deep inferior epigastric artery perforator flap, **LF** - Limberg flaps, **SCIP** - Superficial circumflex iliac artery perforator flap, **V-Y F** - V-Y Fasciocutaneous flap, **BGM** - Bilateral gracilis myocutaneous flap, **UGM** - Unilateral gracilis myocutaneous flap, **BVRAM** - Bilateral Vertical Rectus Abdominis Myocutaneous flap, **UVRAM** - Unilateral Vertical Rectus Abdominis Myocutaneous flap, **OF** - Omental flap, **BFF** - Bilateral fasciocutaneous flap, **UFF** - Unilateral fasciocutaneous flap



Buried Desepidermised fasciocutaneous V-Y advancement flap

The Fasciocutaneous flap (FP) reconstruction is mostly indicated in cases of Superficial defects. The donor site is mainly the gluteal region. Fasciocutaneous flap has recently become the choice of reconstruction for vulvar and vaginal defects as it is less bulky and leaves a less conspicuous scar at the donor site when compared to myocutaneous flap (Windhofer et al., 2011).

Buried desepidermised fasciocutaneous V-Y advancement flap is a relatively easy and time-saving procedure. It is a local and easily applicable fasciocutaneous flap with a rich supply of vascular tissues arising from superior or inferior gluteal arteries. This procedure can be employed in the reconstruction of pelvic defects which happen after a colorectal cancer procedure (Özkaya et al., 2018). Complications likely associated with VRAM FLAP are reduced with this procedure and less likely to occur. It is based on the "replace like with like" principle. The procedure requires less operative time as it is void of complications such as necrosis and mobility-related complications. With this Flap, patients can move around within 4 days. Hence patients do not need to be placed on anticoagulants for a long period as experienced with other procedures such as VRAM and other regional flaps.

Lotus Petal Flap- LP

The LPF is based on the dense network of perforating vessels near the midline of the perineum (Buda et al., 2017).

The lotus petal flap is based on a rich arterial anastomotic network consisting of the perforators of the internal pudendal artery (Hellinga et al., 2018). It derives its name from its architecture which resembles the petals of a lotus flower. However, the shape of the flap does not necessarily resemble that of petals as it is designed to meet the pattern of the reconstructive requirement of the local defect. (Yii and Niranjana, 1996). The flaps are based around the vaginal orifice and so can be easily transposed to cover vulvo-vaginal defects while the donor sites are closed primarily.

In the study by Argenta et al. (2013), involving 59 patients, 14% of patients showed complications with 7 showing flap loss and 4 requiring reoperation. However Hellinga et al., in their analysis of 93 patients reported 69.9% complications ranging from dehiscence, flap loss, and abscess drainage with the Lotus Petal Flap. The average weighted mean complications for 5 retrospective studies involving a total of 196 patients was 51.53%. Dehiscence at 14% and 33.3% respectively for 2 of the studies representing 11.8% of the total, Two studies reported flap loss at 29.4% and 11.8% representing 10.3% of the total, and a single case of Hernia showed 0.89%, 7 cases of infections representing 3.57% of the total reviewed cases. These results were curated from 5 retrospective studies involving purely LPF reconstruction with one modified LPF reconstruction and a case of unilateral and bilateral LPF.



The advantages of the lotus petal flap reconstruction include the versatility of the flaps in clinical situations, the donor site being distant from the malignant lesion site, the tissue not being damaged by radiotherapy, and its generally good post-surgery aesthetic.

V-Y advancement flap

The V-Y advancement flap is a local fasciocutaneous flap that involves mobilizing the adjacent skin and underlying subcutaneous tissue to cover the primary defect. It is named V Y advancement Flap as the "V" represents the initial incision shaped as "V" created along the adjacent skin and underlying subcutaneous tissue that is mobilized over the primary vulvar defect. The "Y" is symbolically how the skin is closed, the latter end signifying the primary sealing of the harvested site (Hand et al., 2018). The technique is of immense use when the donor site is loose enough to allow proper harvesting to cover the defect at the time of commencement of the initial surgery. Hence, the V-Y advancement flap from the medial thigh or gluteal fold island flap has been widely used for vulvovaginal reconstruction by many surgeons. (Lee et al.,2006). Available data indicate that the surgical reconstruction with the V-Y advancement flap technique has led to a reduction in complications and reduced the hospitalization time of patients. It also appears that the rate of recurrence of cancer reduced, recovery sped up and long-term survival has significantly improved with this modified technique. F. Carramaschi et al. (1999). Lara et al. reported that the results 1-year post-surgery proved to be good for compliance of the patients and morphology.

In Buda et al., comparison of V-Y advancement flap and Lotus Petal Flap, a total of 128 patients underwent the V-Y advancement flap. 27(21%) complications were reported with this technique with 11 dehiscence, 8 necrosis, and 4 infections. Comparing this data to Lange, Hage, and Beurden's V-Y advancement flap on 75 patients with 28% complications, 12 dehiscences, 12 necrosis, 1 flap loss, 5 infections, and 16 deaths, and Lazarro et al's Gluteal flap V-Y advancement flap on 8 patients, 1 complication which was necrosis. Analysing the results, the mean of complications in these 3 studies was 20.5%, flap loss average was 0.4%, mean of dehiscence was 8.2%, mean infections were 3.3%, mean necrosis was 11.6%, and mean death was 7.1%.

Partial myocutaneous gluteal flap- PMG flap

A group of studies including a meta-analysis of reconstruction procedures has confirmed that the reconstruction of defects with myocutaneous flaps proves to be superior compared to direct closure. The technique leaves scars that are more extensive than those resulting from primary closure, but it does not inhibit sitting and is well accepted by patients. Angelina et al. (2012).

Bowers et al., in their study of the PMG flap involving 49 patients, comparing PMG



flap with the procedure described by Tan et al. affirmed that PMG follows the same principles involving the separation of the muscle and fasciocutaneous elements of the flap which facilitates pelvic floor reconstruction, dead space obliteration and advancement of non-irradiated skin into the wound with less extensive dissection of the muscle and fasciocutaneous layers. In their study, Bower et al. Reported that out of the 48 patients, 40 reported complications with 12(26%) dehiscence, 6(12.5%) hernia, and 5(10.4%) requiring reoperation and no deaths. Thus it seems the PMG flap meets the need for a muscle-based reconstruction while maintaining gluteal function and is a reliable and patient-friendly reconstruction procedure for vulvoperineal defect.

Thigh Flap and Anterolateral Thigh Flap-ALT/ATF

This is a versatile soft tissue flap that can be harvested as fasciocutaneous or myocutaneous flap. Due to the nature of the vascularization of the harvest site, the flap was considered unusable and ill-advised with patients as septocutaneous vessels supplying the flap were considered present in only a few cases while a majority of its vascular suppliers were the musculocutaneous perforators thus intramuscular dissection was considered unsafe. However, with the advance and development of the perforator flap and subsequent development of intramuscular dissection, this technique regained its prominence as a classic perforator flap. Moreso, due to the nature of its vascularization, the technique requires an in-depth understanding of its vascular anatomy. Chin-Ho Wong and Fu-Chan Wei (2010). The anterolateral thigh flap is a flap of unsurpassed versatility. No other donor site in the body offers such a large amount of tissue with such minimal donor morbidity (Kuo et al. (2001).

The total number of reviewed cases was 51, with 19 patients undergoing thigh flap and 32 patients undergoing the Anterolateral Thigh Flap. These were curated from 3 studies. The mean rate of complications was 52.6%, two studies reported 1 case of dehiscence each, and one study reported 4 flap losses representing 7.8% of the total. 9 infections were reported with the Thigh flap denoting 17.6% of the total reviewed cases.

Vertical Rectus Abdominis Myocutaneous- VRAM

Five retrospective studies and one prospective study described the Vertical Rectus Abdominis Myocutaneous Flap.

Studies have shown that primary reconstruction of the vaginal wall with a VRAM flap has been associated with a low rate of long-term complications and impressive long-term results related to urinary and sexual function of the vagina and stability of the reconstruction. The VRAM Flap has undergone several Adjustments and variations over the years, hence its reconstruction can be designed to suit the peculiarities and needs of the patients (Horch et al., 2020).



Horch et al. (2020), in their study involving a total of 149 patients reported 3.5% Dehiscence with VRAM flap. Also, patients sitting in the long term was not significantly affected.

Nelson and Butler reported 72% complication in the prospective study involving 114 patients who underwent the VRAM Flap Reconstruction.. They also recorded that 41% experienced a reoccurrence of the tumor. However, flap loss total in this study was very minimal at 0.9% of the total. Another retrospective study by Harries et al. in 2021 involving 178 patients that underwent the VRAM flap reconstruction recorded 25.9% dehiscence as part of the complications experienced by the patients. It thus appears that the VRAM Flap may not be a very effective reconstructive technique as it is behoved with complications though possessing minimal advantages such as reduced hospital time and improved ability of the patients to resume normal postural activities minimal long term postural defects.

Gracilis flap

Persichetti et al. (2007) identified the gracilis flap as one of the pioneers to be used in a reconstruction of the perineal region and argued that this technique fosters a quicker recovery following operation. The flap, in contrast with alternative flaps such as the VRAM Flap, possesses the advantage of less extensive dissection, avoidance of the complications associated with abdominal wall mobilization such as reduced abdominal function and weakening, infections, hernias and reduced overall morbidity (Coelho et al., 2019 and Singh et al., 2016).

Two retrospective studies by Singh et al. (2016) and Coelho et al. (2019), involving the Gracilis flap were analysed in this study and the following results were obtained; The mean complication was 50.25%, dehiscence was 13.25%, infections was 13%. Coelho et al. reported a death rate of 40% while Singh et al. reported death rate at 0%.

The rate of complications associated with Gracilis Flap was relatively high and comparable to that experienced with VRAM flap reconstructive technique and other reconstruction techniques employed in vulvo-vaginal reconstruction. However, donor site complications are relatively low when compared to VRAM technique. It can thus be considered as a viable alternative to VRAM technique in vulvo-vaginal and perineal defect reconstruction (Singh et al., 2016).

Conclusion

The early detection of cancer of the vulva, vagina, or perineum is usually followed by a surgical procedure to partially or totally remove the organ. This most often leads to defects. Defects have direct effects on the healing process after surgery and potential consequences of impairing normal functions such as excretion and sexual actions. Therefore, it is usually followed by reconstructive procedures. Examination usually precedes the choice of reconstruction and patient needs are also considered



in making such choice. Cordeiro classified defects pertinent to the vagina which informs choice of reconstructive process.

Asides from the risks associated with the use of any of the outlined flaps above, individual patient risk exists due to their demographics, medical history, social history, etc. VRAM records the highest complications rate due to the nature and location of the donor site at the (abdomen). Lotus Petal Flap from the studies shows a relatively low complications rate compared to other techniques. However, results from gracilis flap are similar to those obtained with the VRAM flap.

Finally, the risks involved should always be evaluated before carrying out any reconstruction to ensure suitability.

References

Argenta, P.A., Lindsay, R., Aldridge, R.B., Siddiqui, N., Burton, K., Telfer, J.R. (2013). Vulvar reconstruction using the "lotus petal" fascio-cutaneous flap. *Gynecol Oncol*. **131**(3):726-9. doi: 10.1016/j.ygyno.2013.08.030.

Balogun, T. A. (2022). Critical Review on Reconstructive Options for Vulvo-Vaginal Defects. *Journal of Surgery and Research* **5** (2022): 212-220.

Bell, S.W., Dehni, N., Chaouat, M., Lifante, J.C., Parc, R., Tiret, E. (2005). Primary rectus abdominis myocutaneous flap for repair of perineal and vaginal defects after extended abdominoperineal resection, *British Journal of Surgery*, **92**(4):482–486, <https://doi.org/10.1002/bjs.4857>

Bodin, F., Weitbruch, D., Seigle-Murandi, F., Volkmar, P., Bruant-Rodier, C., Rodier, J.F. (2012). *Vulvar reconstruction by a "supra-fascial" lotus petal flap after surgery for malignancies.* , **125**(3), doi:10.1016/j.ygyno.2012.03.029

Bowers, C., Chandrasekar, B., Dargan, D., & Mohammed, P. (2022). Partial myocutaneous gluteal flap for perineal reconstruction of extralevator abdominoperineal defects. A single surgeon series of 49 cases in 8 years, and a modification of the technique. *Journal of Plastic, Reconstructive & Aesthetic Surgery*, **75**(1), 125-136.

Buda, A., Confalonieri, P.L., Rovati, L.C.V., Signorelli, M. and Del Bene, M. (2012). Tunneled modified lotus petal flap for surgical reconstruction of severe introital stenosis after radical vulvectomy. *International Journal of Surgery Case Reports*, **3**(7), pp.299-301.

Carramaschi, F., Ramos, M.L.C., Nisida, A.C.T., Ferreira, M.C., and Pinotti, J.A. (1999). "V-Y flap for perineal reconstruction following modified approach to vulvectomy in



vulvar cancer." *International Journal of Gynecology & Obstetrics* **65**(2): 157-163.

Coelho, J.A.J., McDermott, F.D., Cameron, O., Smart, N.J., Watts, A.M., Daniels, I.R. (2019). Single centre experience of bilateral gracilis flap perineal reconstruction following extra-levator abdominoperineal excision. *Colorectal Dis.* **21**(8):910-916. doi: 10.1111/codi.14654

Coltro, P.S., Busnardo, F.F., Mònaco, F.F.C., Olivan, M.V., Millan, L.S., Grillo, V.A., Marques, C.F., Nahas, C.S., Nahas, S.C., Ribeiro, U.Jr., Gemperli, R. (2017). Outcomes of Immediate Internal Pudendal Artery Perforator Flap Reconstruction for Irradiated Abdominoperineal Resection Defects. *Dis Colon Rectum.* **60**(9):945-953. doi: 10.1097/DCR.0000000000000875.

Devulapalli, C., Jia, W., Anne, T., DiBiagio, J.R., Baez, M.L., Baltodano, P.A., Seal, S.M., Sacks, J.M., Cooney, C.M., Rosson, G.D. (2016). Primary versus Flap Closure of Perineal Defects following Oncologic Resection. *Plastic and Reconstructive Surgery,* **137**(5):1602–1613. doi:10.1097/prs.0000000000002107

Elia, J., Do, N.T.K., Chang, T.N.J., Lai, C.H., Chou, H.H., Chang, F.C.S., & Huang, J.J. (2021). Redefining the Reconstructive Ladder in Vulvoperineal Reconstruction: The Role of Pedicled Perforator Flaps. *Journal of Reconstructive Microsurgery.* doi:10.1055/s-0041-1727199

Franchelli, S., Leone, M.S., Bruzzzone, M., Muggianu, Puppo, A., Gustavino, C., Di Capua, E., Centurioni, M.G. (2009). The gluteal fold fascio-cutaneous flap for reconstruction after radical excision of primary vulvar cancers, **113**(2): 245–248. doi:10.1016/j.ygyno.2009.01.017

Hage, J.J., Lange, M., Zijlmans, H.J., van Beurden, M. (2018). Repeated Use of Gluteal Fold Flaps for Post–Oncologic Vulvoperineal Reconstruction. *Annals of Plastic Surgery,* doi:10.1097/SAP.0000000000001445

Harries, R.L., Radwan, R.W., Dewi, M., Cubitt, J., Warbrick-Smith, J., Drew, P. (2021). Outcomes Following Immediate Vertical Rectus Abdominis Myocutaneous (VRAM) Flap-Based Perineal Reconstruction Following Resectional Surgery For Pelvic Malignancies. *World Journal of Surgery,* **45**(7), 2290–2297. doi:10.1007/s00268-021-06044-0

Hellinga, J., Khoe, P.C.K.H.; van Etten, B., Hemmer, P.H.J., Havenga, K., Stenekes, M.W., Eltahir, Y. (2016). Fasciocutaneous Lotus Petal Flap for Perineal Wound Reconstruction after Extralevator Abdominoperineal Excision: Application for Reconstruction of the Pelvic Floor and Creation of a Neovagina. *Annals of Surgical Oncology,* **23**(12):4073–4079. doi:10.1245/s10434-016-5332-y



Hellinga, J., Khoe, P.C.K.H., Stenekes, M.W., Eltahir, Y. (2018). Complications After Vulvar and Perineal Reconstruction With a Lotus Petal Flap. *Annals of Plastic Surgery*, doi:10.1097/SAP.0000000000001271

Hellinga, J., Stenekes, M.W., Werker, P.M.N. *et al.* (2020). Quality of Life, Sexual Functioning, and Physical Functioning Following Perineal Reconstruction with the Lotus Petal Flap. *Ann Surg Oncol* 27:5279–5285 <https://doi.org/10.1245/s10434-020-08771-5>

Hellinga, J. and Fleer, J. (2021) 'Aesthetic Outcomes of Perineal Reconstruction with the Lotus Petal Flap', *Plast Reconstr Surg Glob Open*

Huang, J., Chang, N., Chou, H., Wu, C., Abdelrahman, M., Chen, H., Cheng, M. (2015). Pedicle perforator flaps for vulvar reconstruction – New generation of less invasive vulvar reconstruction with favorable results. *Gynecologic Oncology*, 137(1), 66–72. doi:10.1016/j.ygyno.2015.01.526

Kim, J.T., Samuel, Y.M., Hwang, J.H., Lee, J.H. (2014). Perineal Perforator–Based Island Flaps. *Plastic and Reconstructive Surgery*, 133(5):683e–687e. doi:10.1097/prs.0000000000000146

Kuo Y.R., Jeng S.F., Kuo M.H., et al. (2001). Free anterolateral thigh flap for extremity reconstruction: clinical experience and functional assessment of donor site. *Plast Reconstr Surg* 107:1766–1771.

Lange, M., Hage, J.J., van Beurden, M. (2017). A Prospective Assessment of Surgical Risk Factors in 114 Gluteal Fold Flap Reconstructions After Oncological Vulvoperineal Resection. *Annals of Plastic Surgery*, 79(1), 53–59. doi:10.1097/sap.0000000000000964

Lazzaro, L., Guarneri, G.F., Rampino C.E. *et al.* (2010). Vulvar reconstruction using a “V-Y” fascio-cutaneous gluteal flap: a valid reconstructive alternative in post-oncological loss of substance. *Arch Gynecol Obstet* 282, 521–527. <https://doi.org/10.1007/s00404-010-1603-1>

Lee, P., Moon-Seop Choi, Sang-Tae Ahn, Deuk-Young Oh, Jong-Won Rhie, and Ki-Taik Han. "Gluteal fold VY advancement flap for vulvar and vaginal reconstruction: a new flap." *Plastic and reconstructive surgery* 118, no. 2 (2006): 401-406.

Libertucci, J., Young, V.B. (2019). *The role of the microbiota in infectious diseases. Nature Microbiology*, 4(1), 35–45. doi:10.1038/s41564-018-0278-4

Muneuchi, G., Ohno, M., Shiota, A., Hata, T., Igawa, H.H. (2005). Deep Inferior Epigastric Perforator (DIEP) Flap for Vulvar Reconstruction After Radical Vulvectomy.



Annals of Plastic Surgery, **55(4)**, 427–429.
doi:10.1097/01.sap.0000171425.83415.fa

Nelson, R.A., Butler, C.E. (2009). Surgical Outcomes of VRAM versus Thigh Flaps for Immediate Reconstruction of Pelvic and Perineal Cancer Resection Defects. *Plastic and Reconstructive Surgery*, **123(1)**, 175–183. doi:10.1097/prs.0b013e3181904df7

Nelson, G., Bakkum-Gamez, J., Kalogera, E., et al. (2019). *Int J Gynecol Cancer* 29:651–668.

O'Dey, D., Bozkurt, A., Pallua, N. (2010). The anterior Obturator Artery Perforator (aOAP) flap: Surgical anatomy and application of a method for vulvar reconstruction. **119(3)**, 526–530. doi:10.1016/j.ygyno.2010.08.033

Özkaya, Ö., Sahin, A.E., Üsçetin, I., Güven, H., & Saglam, F. (2018). Immediate perineal reconstruction after extralevatory abdominoperineal excision: buried desepidermised fasciocutaneous VY advancement flap. *Annals of Plastic Surgery*, **80(2)**:154-158.

Panici, P.B., Di Donato, V., Bracchi, C., Marchetti, C., Tomao, F., Palaia, I., Perniola, G. and Muzii, L. (2014). Modified gluteal fold advancement VY flap for vulvar reconstruction after surgery for vulvar malignancies. *Gynecologic Oncology*, **132(1)**:125-129.

Peiretti, M., Corvetto, E., Candotti, G., Angioni, S., Figus, A., & Mais, V. (2019). New Keystone flap application in vulvo-perineal reconstructive surgery: A case series. *Gynecologic oncology reports*, **30**:100505.
<https://doi.org/10.1016/j.gore.2019.100505>

Persichetti, P., Cogliandro, A., Giovanni, F., Simone, P., Ripetti, V., Vitelli, C.E., Coppola, R. (2007). Pelvic and Perineal Reconstruction Following Abdominoperineal Resection. *Annals of Plastic Surgery*, **59(2)**:168–172. doi: 10.1097 / 01.sap.0000252693.53692.e0

Radwan, R.W., Tang, A.M., Harries, R.L., Davies, E.G., Drew, P., Evans, M.D. (2020). Vertical Rectus Abdominis Flap (Vram) for Perineal Reconstruction following Pelvic Surgery: A Systematic Review, *Journal of Plastic, Reconstructive & Aesthetic Surgery*, doi: <https://doi.org/10.1016/j.bjps.2020.10.100>

Salgado, C.J., Chim, H., Skowronski, P.P., Oeltjen, J., Rodriguez, M., & Mardini, S. (2011). Reconstruction of acquired defects of the vagina and perineum. *Seminars in plastic surgery*, **25(2)**:155–162. <https://doi.org/10.1055/s-0031-1281485>

Samara, M., Somen, E., and Mijatovic, D. (2019). Patient with Malignant Vulvar Neoplasm: Case Report. *Acta Chir Croat* **16**: 35-37



Singh, M., Kinsley, S., Huang, A., Ricci, J.A., Clancy, T.E., Irani, J., Goldberg, J., Breen, E., Bleday, R., Talbot, S.G. (2016). Gracilis Flap Reconstruction of the Perineum: An Outcomes Analysis. *Journal of the American College of Surgeons*, *S1072751516306536*-. doi:10.1016/j.jamcollsurg.2016.06.383

Stéphanie, T., Jennifer, W., Marine, B., Delphine, H., Louise, G., Fabrice, N., Eric, L. (2019). Outcomes of the use of different vulvar flaps for reconstruction during surgery for vulvar cancer. *European Journal of Surgical Oncology*, *()*, *S0748798319304044*-. doi:10.1016/j.ejso.2019.04.012

Tan, B.K., Terence, G., Wong, C.H., Sim, R. (2012). Lower gluteal muscle flap and buttock fascio-cutaneous rotation flap for reconstruction of perineal defects after abdomino-perineal resections. *J Plast Reconstr Aesthet Surg* **65**:1678–83.

Westbom, C.M., & Talbot, S.G. (2019). An Algorithmic Approach to Perineal Reconstruction. *Plastic and reconstructive surgery. Global open*, *7*(12):e2572. <https://doi.org/10.1097/GOX.0000000000002572>

Windhofer, C., Papp, C., Staudach, A., Michlits, W. (2012). Local Fasciocutaneous Infragluteal (FCI) Flap for Vulvar and Vaginal Reconstruction. *International Journal of Gynecological Cancer*, **22**(1), 132–138. doi:10.1097/igc.0b013e318234fa0a

Wong, C.H., & Wei, F.C. (2010). Anterolateral thigh flap. *Head & Neck. Journal for the Sciences and Specialties of the Head and Neck*, **32**(4), 529-540.

Yii, N.W., & Niranjana, N.S. (1996). Lotus petal flaps in vulvo-vaginal reconstruction. *British journal of plastic surgery*, **49**(8):547-554.

Zeng, A., Qiao, Q., Zhao, R., Song, K., Long, X. (2011). Anterolateral Thigh Flap–Based Reconstruction for Oncologic Vulvar Defects. *Plastic and Reconstructive Surgery*, **127**(5):1939–1945. doi:10.1097/prs.0b013e31820e9223

Zhang, W., Zeng, A., Yang, J. *et al.* (2015). Outcome of vulvar reconstruction in patients with advanced and recurrent vulvar malignancies. *BMC Cancer* **15**(851). <https://doi.org/10.1186/s12885-015-1792-x>

