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Reconstruction using the lotus petal flap

Oosta-Hellinga, Joke

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Reconstruction using the lotus petal flap

applications and outcomes

Joke Hellinga

Reconstruction using the lotus petal flap: applications and outcomes

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Reconstruction using the lotus petal flap

Applications and outcomes

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Joke Hellinga

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te Leeuwarden

Promotor

Prof. dr. P.M.N. Werker

Copromotores

Dr. M.W. Stenekes

Dr. B. van Etten

Beoordelingscommissie

Prof. dr. M.J.E. Mourits

Prof. dr. B.L. van Leeuwen

Prof. dr. D.J.O. Ulrich

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CHAPTER 1

General introduction and outline of thesis

GENERAL INTRODUCTION

This thesis focuses on the outcome of the application of the lotus petal flap (LPF) reconstruction technique for extensive vulvar and perineal reconstruction, and more specifically, on reconstruction related complications, quality of life (QoL), sexual function, and functional and aesthetic outcomes. This general introduction will start with a short overview of the relevant anatomy of the vulvoperineal region, followed by the description of the reasons for vulvoperineal resections and related risk factors for subsequent wound healing problems in this area. Different options for closure of these defects will thereafter be discussed, including the LPF reconstruction technique, with their advantages and disadvantages. This will lead to the main research question of this thesis and the outline of this thesis.

Anatomy and function of the vulvoperineal region

The vulvoperineal region is the area inferior to the pelvic diaphragm (Figure 1). The region is diamond shaped and can be divided in an anterior urogenital triangle and a posterior anal triangle. The pelvic diaphragm is formed by a strong network of muscles, with the levator ani and transverse perineal muscles as main components. This network of muscles supports the organs of the lesser pelvis. It allows their output passages to pass towards the external genitalia in the urogenital triangle and the anal complex in the anal triangle. Besides, this network of muscles forms the pelvic floor and creates stability to the perineum.

Figure 1. Bloodsupply of the vulvoperineal region

The blood supply of the vulvoperineal area is very abundant and in that respect very comparable to that of the face. The anterior triangle of the vascularization of the vulvoperineal area is supplied by branches of the femoral artery: the superficial and deep external pudendal arteries. The posterior triangle is supplied on each side by a branch of the internal iliac artery: the internal pudendal artery. Both vascular systems give rise to an extensive vascular network, which is interconnected to its neighboring networks by means of numerous anastomotic choke vessels. This network is the basis of perforators, which guarantee the vascular supply of the region, even following extensive local resection or inguinal dissection.^{1,2} The sensibility of the area is provided by the perineal branches of the pudendal nerve, which accompany the pudendal artery perforators.³⁻⁶

Pathology of the vulvoperineal region

Malignant tumors in the vulvoperineal region are most often vulvar, rectum or anal tumors. The tumors are classified according to the TNM-classification system. The T shows the size of the primary tumor, the N the regional lymph nodes status and the M the distant metastasis.⁷

Malignant tumors in the vulvoperineal region

Locally advanced (i.e. T4 or bulky) vulvar tumors are mostly treated with wide tumor excision or radical vulvectomy. Vulvar excision may lead to a skin defect which, in some cases, extends into the vagina.² Adjuvant radiotherapy is applied in cases with positive lymph nodes. Chemotherapy or neoadjuvant radiotherapy is most often not applied.⁷

Abdominoperineal excision (APE) is the standard treatment for tumors of the anal canal or distal rectum, in which the anal sphincter cannot be preserved (tumor >2 cm).⁸⁻¹⁰ During this procedure the anus, rectum, and part of the sigmoid colon are usually resected.^{11,12} In case of distal rectal cancer not involving the external sphincter, an intersphincteric APE (including resection of internal anal sphincter) can be performed. However, in case of external sphincter involvement, an extralevator APE (ELAPE) (including internal and external anal sphincter and resection of levator muscle) is performed (Figure 2).¹³ Perineal excision may lead to a skin defect, but, especially ELAPE, usually leaves an extensive soft tissue defect in the lesser pelvis.^{8,14} In cases with advanced tumors or recurrent disease, a combined resection of the vulvar and perineal area or resection of part of the vagina wall, and even (part of the) bladder may be performed leading to even bigger soft tissue loss and defect.

In most patients with >T2 anal squamous cell carcinoma, definitive radio- and chemotherapy is applied but in non-responders or recurrent disease salvage APE with wide perineal excision is indicated. In patients with rectal adeno carcinoma neoadjuvant radio- and/or chemotherapy is applied in N+ disease, mesorectal fascia involvement, or T4 tumors.¹⁵

Figure 2.

Left: intersphincteric APE, performed medially from the levator ani, separating the levator ani from the rectum; **Right:** extralevator APE, levator ani is divided as proximal as possible to its pelvic attachment.

Closure of vulvoperineal defects

The vulvoperineal defects that result after resection of vulvar-, rectal- or anal tumors as described above are often extensive. Smaller defects may be closed primarily. However, this is often not achievable after excision of advanced tumors or only possible under tension or vital structures are exposed.^{16,17} Primary closure under tension increases the chance of wound dehiscence, delayed healing and infection.^{16,18} Delayed healing and contractures often occurs, leading to a bad (57%) or just acceptable (43%) cosmetic and functional result, graded on a four-point scale from bad to excellent.¹⁹ Also, dead space may remain when only primary closure is performed. Therefore, primary closure is usually not successful in reconstructions of the vulvoperineal area.¹ Skin grafts also have limited success. They are difficult to fixate and there is a high risk of infection leading to graft loss.^{2,17,20,21} Also, the risk of shearing is high, which may lead to inadequate take or graft loss.¹⁷ Use of skin grafts may lead to contractures and unsatisfactory cosmetic results. Contractures may cause vaginal stenosis, which affects urination or sexual intercourse in females.^{2,20,22}

The best option for major wound closure in many cases is the use of flaps. Reconstruction with a flap is a more extensive procedure compared to earlier mentioned options and results in a donor site. However, the addition of tissue has multiple advantages. A flap adds well vascularized, non-irradiated soft tissue to fill the dead space and provides adequate skin cover.^{8,23,24} A flap is able to resist a bacterial infection and maintain or even improve blood supply. This enables the supply of oxygen and leukocytes to the defects.²⁵ Wound closure with a soft tissue flap has been found to reduce the risk of wound healing problems.²⁶ Functional results following reconstruction with a flap are better compared to skin grafting.¹⁶

A study of Darrach et al. on defect closure following oncological resection comparing a perforator based fasciocutaneous flap with skin grafting also shows a faster healing process, shorter mobility restriction, and comparable complication rates in the flap closure group compared to the skin graft closure group.²⁷

Reconstruction with flaps

In general, an ideal reconstruction restores both form and function. Winterton et al. elaborated on this and defined characteristics of an ideal reconstruction as follows. The reconstruction technique needs to: 1) provide enough tissue to fill the dead space; 2) provide enough skin to cover the skin defect; 3) facilitate rapid wound healing; 4) lie away from the way of tumor spread; 5) have a low donor site morbidity; 6) provide protective sensibility; and 7) reconstruct the vagina if necessary.²⁰

Pedicled (local, regional, distant) and free flaps can be distinguished in the following ways. In a local flap, tissue adjacent to the defect is used, while in regional flaps tissue near the defect, but not directly adjacent to the defect is used. In distant flaps there is no original relation between donor and recipient area. The classic example is a pedicled groin flap for a defect of a hand. In pedicled flaps the vascularity of the flap remains intact through the remaining pedicle, while in free flaps anastomoses of the feeding blood vessels are required to restore the blood supply.

Pedicled flaps can be muscular only, musculocutaneous (skin and muscle) or fasciocutaneous (skin and fat with underlying fascia). Examples of muscle/musculocutaneous flaps commonly used for reconstruction of vulvoperineal area include the gracilis flap and the vertical rectus abdominis myocutaneous (VRAM) flap.⁸ The gracilis flap was first described in 1976 by McCraw.²⁸ This flap is known for its reliable blood supply. However, the location of the pedicle limits the mobility of the flap. Also, the scar on the donor location, and the bulkiness of the pedicle, if a skin paddle taken, are clearly noticeable.^{1,2,21} The VRAM flap has a rich vascularization and offers enough bulk for extensive defects as seen following perineal resection.⁸ After vulvar resections, however, there is usually no dead space and a flap is required to close a skin/mucosa defect. In these cases, a bulky VRAM flap may be a disadvantage.^{16,29} With VRAM flaps there is also a relatively high risk of donor site morbidity, especially abdominal wall herniation.^{17,18,29} When abdominal wall herniation occurs, there is a risk of bowel strangulation and perforation. Furthermore, extensive scarring may occur with loss of the abdominal contour and umbilical position.¹⁸ Besides, if the rectus abdominis muscle is used for colo- or urostomy placement, it cannot be used for transposition.⁸ Another disadvantage of the use of the VRAM is that its harvest may require intraoperative repositioning of the patient.

Another option for a local or regional flap is a fasciocutaneous (skin and fat with underlying fascia) flap. In the 1980s fasciocutaneous flaps were used for

reconstruction of vulvoperineal defects. The superomedial thigh flap, medial thigh flap and gluteal thigh flap are all based on the vascular pedicles from the thigh or gluteal area.^{16,30,31} A disadvantage of these flaps are the conspicuous scars at the donor site on the thigh.^{5,16,30,31} In the 1990s more interest emerged towards the vascularization of the perineum and surrounding area by the internal and external pudendal vessels. The pudendal thigh flap, vulvoperineal fasciocutaneous flap and the perineal artery axial flap are all based on the reliable vascularity of the terminal branches of the internal pudendal vessels (Figure 1).^{16,30,32} These vessels stay intact, even after tumor resection or radiation of the inguinal and perineal area.⁶ However, the pudendal thigh flap and vulvoperineal fasciocutaneous flap are in the path of tumor spread due to tumor growth and are often excised with the tumor. The perineal artery axial flap was first described in 1988.³³ With the current knowledge, it is one particular (medial) petal of the lotus petal flaps (see below). It is limited in size and therefore not suitable for extensive defects.^{16,30,31}

Lotus petal flap reconstruction

The lotus petal flap (LPF) is a local fasciocutaneous flap based on the perforators of the internal pudendal artery. The flap was first described for reconstruction of vulvovaginal defects. The flap can be taken in many directions and is named after its design, resembling the petals of the lotus flower (Figure 3).¹ The most horizontal 'petal' of the LPF is also known as a gluteal fold flap.¹⁸ The flap has been modified by Warrier in 2004 into a subcutaneous flap to create more versatility without compromising its reliability.²¹

The LPF has been found to have many positive characteristics and contains all of the earlier mentioned characteristics of an ideal reconstruction, except for

Figure 3. The different petal options of the lotus petal flap

sensibility, which is mostly lacking. First, the flap provides enough tissue to fill the dead space that remains after extensive tumor resection. Second, it provides skin to close a skin defect. Third, the flap is very versatile.^{1-3,5} Different ‘petals’ of the flap may be used, depending on the size and location of the defect. The thickness can be adjusted to the depth of the defect, the length and width can be adjusted to the defect. Also, bilateral use or a combination with other flaps can be applied, depending on the volume needed.¹⁸ In extensive defects two flaps can even be stacked, one being deepithelialized. Because of the versatility in location, thickness and size, the flap is suitable for a broad range of vulvar, perineal and vulvoperineal defects. Fourth, the flap facilitates rapid wound healing since the majority of the tissue used for the flap is located outside the area of radiotherapy, positively influencing the prevention of recurrence and wound healing.^{1-3,18,34} Fifth, the flap is raised away from the path of tumor spread.^{1-3,18,34} Sixth, the flap has a low donor site morbidity since the donor site is often located in the gluteal fold, resulting in a relatively inconspicuous scar, which can be hidden by underwear.^{1-3,5,18} Furthermore, only subcutaneous tissue and skin is used, thereby preventing any compromise of functionality.¹⁸ Seventh, reconstruction of the vaginal wall is possible if necessary. Eighth, the flap is relatively easy to raise and the procedure can be performed quickly. Also, the flap can be raised in either lithotomy or prone position. This avoids having to reposition the patient intra-operatively, which may be time consuming and carries an extra risk during surgery for anesthesiological problems, pressure sores and neuropathy.¹⁸

Complications following flap reconstruction

Possible complications following reconstruction with a flap include general surgical complications like wound healing problems (e.g. dehiscence) or wound infection. Also, flap-specific complications may occur at either the flap (e.g. (partial) flap failure) or the donor site (e.g. wound dehiscence).³⁵ Studies on complications following LPF reconstruction have mostly been small. One larger study showed a complication rate of 36%, mainly wound dehiscence. No complete flap loss occurred, but partial flap loss occurred in 9% of the patients.³⁶

Specific risk factors for delayed wound healing in the perineum

Surgery in the vulvoperineal area has a high risk of wound healing complications. The area has a humid environment and is by definition colonized by bacteria (e.g. staphylococcus and anaerobic bacteria).^{14,17,23} Especially following (EL)APE the bacterial contamination (e.g. *E. coli* and streptococcus) increases because of bowel resection.⁸ The large dead space that sometimes remains in the pelvis has a high risk of fluid accumulation. This is especially true in the smaller pelvic area, where the lateral borders are bony structures, which prevents collapse to fill the dead space.^{8,14,20,23} Fluid accumulation increases the risk of abscess formation.^{12,20} Therefore it is important to fill the dead space after an extensive resection.²⁰ Another risk factor for disturbed wound healing in the vulvoperineal area is the physical stress due to movement and the pressure effects from sitting or lying.¹⁷

Besides risk factors of the vulvoperineal area, other patient factors also influence wound healing. Advanced disease, malnourishment caused by extensive tumors, (neo) adjuvant chemo- or radiotherapy, smoking and comorbidities increase the risk of wound complications.^{14,17,18,24} Patients with cancer are vulnerable and often experience symptoms like nausea and vomiting. Those symptoms may cause problems like dehydration and aggravate malnutrition.³⁷ Malnutrition causes delayed wound healing due to an extended inflammatory process, a decrease in fibroblast proliferation, and a lack of collagen formation.³⁸ Radiotherapy further increases the risk of wound complications because it induces fibrosis. In the long term radiotherapy reduces the vascularity of the tissue surrounding the defect and causes skin damage by formation of oxygen free radicals.^{8,9,12,23,37} Chemotherapy directly affects cell metabolism and therefore also the wound healing.³⁹ Smoking increases the risk of wound healing complications in plastic surgery procedures in general by two to three times.⁴⁰ Comorbidity may also influence wound healing; for example patients with diabetic disease often have a poor vascular circulation, which negatively influences wound healing.⁴¹

Outcome measures of lotus petal flap reconstruction

Most research on reconstruction with the LPF has been performed in small studies and is mostly focused on the complications in a subjective manner. Complications were found to negatively influence the length of hospital stay, care

Table 1. Clavien-Dindo classification

Grade	Definition
I	Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic and radiological interventions. Acceptable therapeutic regimens are: drugs as antiemetics, antipyretics, analgetics, diuretics and electrolytes and physiotherapy. This grade also includes wound infections opened at the bedside.
II	Requiring pharmacological treatment with drugs other than such allowed for grade I complications. Blood transfusions and total parenteral nutrition are also included.
III	Requiring surgical, endoscopic or radiological intervention
III-a	intervention not under general anesthesia
III-b	intervention under general anesthesia
IV	Life-threatening complication (including CNS complications) requiring IC/ICU-management
IV-a	single organ dysfunction (including dialysis)
IV-b	multi organ dysfunction
V	Death of a patient

needed, patient's well-being and return to participation in daily life.⁴² Because of the impact of complications, it is important to objectively report complications using a classification system. In the surgical field, the Clavien-Dindo classification system is widely used. This classification system is based on the burden of the complication for subsequent care and the need for additional medicinal or surgical interventions (Table 1).^{43,44}

Outcome in terms of QoL and sexual, functional, and aesthetic outcomes following reconstruction with LPF in the vulvoperineal area has not been previously reported. Such studies following vulvoperineal reconstruction only have been done with other techniques such as VRAM or gluteal flap reconstruction. These studies show that reconstructive surgery has a large impact on QoL and sexual functioning on one hand, but also recognize that research with validated questionnaires is needed.^{11,45}

Aim

The main aim of this thesis was to study the outcome of vulvoperineal reconstruction with the LPF technique in terms of QoL, sexual function, and aesthetics. To this aim, the following studies were designed:

OUTLINE OF THESIS

Part I of this thesis concerns vulvoperineal reconstruction in general. To date, in the literature, the VRAM flap is applied mostly for reconstruction of vulvoperineal defects. However, the LPF is increasingly being applied, and our favorite flap at the University Medical Center Groningen. In **Chapter 2** we systematically review the complications reported following the VRAM flap and LPF reconstruction. In **Chapter 3** we focus on the complications we encountered following reconstruction with the LPF in our clinic. The focus in **Chapter 4** is on QoL and sexual functioning following vulvar reconstruction with the LPF.

Part II of the thesis concerns perineal reconstruction with the LPF. **Chapter 5** describes our experience with the application for perineal reconstruction. **Chapter 6** concerns the outcomes following perineal reconstruction with the LPF, and focuses on QoL, sexual and physical functioning. The aesthetic outcome, a recently highlighted aspect of LPF reconstruction, is reported in **Chapter 7**.

A general discussion of our findings and future research perspectives completes this thesis.

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PART I

Vulvoperineal reconstruction using the lotus petal flap

CHAPTER 2

Lotus petal flap and vertical rectus abdominis myocutaneous flap in vulvoperineal reconstruction: a systematic review of differences in complications

Joke Hellinga
Mathijs Rots
Paul M.N. Werker
Martin W. Stenekes

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ABSTRACT

Background

Vulvoperineal defects resulting from surgical treatment of (pre)malignancies may result in reconstructive challenges. The vertical rectus abdominis muscle flap and, more recently, the fasciocutaneous lotus petal flap are often used for reconstruction in this area. The goal of this review is to compare the postoperative complications of application of these flaps.

Methods

A comprehensive literature search of the PubMed, MEDLINE and Cochrane Library databases was performed until 6 June 2020. Search terms included the lotus petal flap, vertical rectus abdominis muscle flap and the vulvoperineal area. Articles were independently screened by two researchers according to the PRISMA-guidelines.

Results

A total of 1074 citations were retrieved and reviewed, of which 55 were included for full text analysis. Following lotus petal flap reconstructions, the complication rate varied from 0.0% to 69.9%, with more complications concerning the recipient site compared with the donor site complications (26.0% versus 4.5%). Following vertical rectus abdominis muscle flap reconstructions the complication rate varied between 0.0% to 85.7% with almost twice the number of recipient site complications compared to donor site complications (37.1% versus 17.8%).

Conclusion

Overall, the lotus petal flap has lower complication rates at both the donor and the recipient site compared with the vertical rectus abdominis muscle flap. When both options seem viable, the lotus petal flap procedure may be preferred on the basis of the reported lower complication rates.

INTRODUCTION

The surgical treatment of gynecological and colorectal (pre)malignancies may result in vulvoperineal defects that cannot be closed primarily. The ablation leaves a soft tissue defect in an area of the body, where the bacterial count is high. Therefore, it is not surprising that wound infections are often encountered.¹ Besides, most patients receive neoadjuvant or adjuvant (chemo)radiotherapy which may cause delayed wound healing and increases the risk of developing wound complications.² Wound complications occur in up to 22% of the cases with vulvoperineal wound closure without application of flaps.³ It has been proven that wound closure using a flap reconstruction helps to decrease the rate of wound healing problems to 16%, by providing healthy, well-vascularized, and nonirradiated tissue.⁴⁻⁶

There are several reconstructive options for closure of vulvoperineal defects that cannot be closed by simple wound edge adaptation. One of the most commonly used myocutaneous flaps, is the vertical rectus abdominis myocutaneous (VRAM) flap.⁷ This flap has a rich vascularization and offers enough bulk to fill pelvic defects; however, in up to 25% of cases, abdominal wall herniation is described.⁸ Abdominal wall herniation in itself carries the risk of bowel strangulation and perforation. The most commonly used fasciocutaneous flap for the reconstruction of vulvoperineal defects in our practice is the lotus petal (LP) flap. This flap is based on the internal and external pudendal arteries and is a versatile flap. Flap harvest does not impair the donor site functionally and leaves a relatively inconspicuous scar. Nevertheless, rates of minor wound complications of 30% and risk of perineal herniation of up to 21% are still at hand.^{2,9} Ten years ago the VRAM flap was the most commonly used flap for vulvoperineal reconstruction.⁶ Nowadays an LP flap also appears a viable option for reconstruction in the area. In our clinic, we have positive experiences with the LP flap. We experienced the LP flap procedure as a quick and easy to perform procedure, which can be performed in either prone or lithotomy position. Also, the donor site is left with just minimal functional compromises and results in an inconspicuous, easy to hide, scar.¹⁰ Earlier reports show an acceptable major complication rate.¹¹ Therefore, over the past decade, it has become the first option for reconstruction of vulvoperineal defects. However, the advantages and disadvantages of these reconstructions have never been systematically reviewed.

The purpose of this study is to provide a thorough analysis of the literature regarding postoperative complications following reconstruction of vulvar, perineal or vulvoperineal defects with a VRAM or LP flap. Our goal is to review whether or not there are differences in complications in general and differences between the complications occurring at the donor site and recipient site more specific. We aim to identify evidence-based advantages and disadvantages of each reconstruction procedure. This information can help the plastic surgeon during patient counseling, decision making and follow-up.

METHODS

Study selection

This systematic review was performed according to the guidelines of the Cochrane Collaboration and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (www.prisma-statement.org). The protocol was developed a priori and registered in the PROSPERO database (CRD42017056537).

The search strategy was conducted in collaboration with an information specialist of the University Medical Center Groningen medical library. The search strategy was developed using the PICO method. The participants (“P”) were patients with vulvar, perineal or vulvoperineal defects, the intervention (“I”) was either an LP flap or a VRAM flap. The comparison (“C”) and outcome (“O”) were left open to assure a wide search result. The search strategies are shown in Table 1. An initial literature search was performed on 13 October 2015 in the PubMed and Embase database. The search was updated on 6 June 2020. References of all included studies were screened for eligibility.

Table 1. Search strategies

Pubmed	["Vulva"[Mesh] OR "Perineum"[Mesh] OR "Colorectal Neoplasms"[Mesh] OR "Genital Neoplasms, Female"[Mesh] OR vulv*[tw] OR perine*[tw] OR rectal[tw] OR pudend*[tw] OR vagina*[tw] OR neovagin*[tw]] AND ("Surgical Flaps"[Mesh] OR flap*[tw]) AND (lotus[tw] OR gluteal[tw] OR rectus abdomin*[tw] OR VRAM[tw] OR myocutan*[tw])
Embase	'vagina'/exp OR 'female genital tract tumor'/exp OR 'perineum'/exp OR 'rectum tumor'/exp OR vulv*:ab,ti OR perine*:ab,ti OR rectal:ab,ti OR pudend*:ab,ti OR vagina*:ab,ti OR neovagin*:ab,ti AND ('surgical flaps'/exp OR flap*:ab,ti) AND (lotus:ab,ti OR gluteal:ab,ti OR 'rectus abdominis':ab,ti OR 'rectus abdominus':ab,ti OR vram:ab,ti OR myocutan*:ab,ti)

Table 2. Inclusion- and exclusion criteria

Inclusion	Exclusion
Report of donor and recipient site complications	No new data
Reconstruction of vulvar, perineal or vulvoperineal defects	Less than five cases
Reconstruction with either a VRAM or an LP flap	Another language than English, German or Dutch
	No report of outcomes for each flap type or defect type separately
	No full-text available (exclusion in full-text round)

LP: lotus petal, VRAM: vertical rectus abdominis myocutaneous

The study selection was performed in two rounds: 1) title-abstract round; 2) full-text round. Two authors (J.H. and M.R.) independently assessed all articles retrieved from the search. After each round discrepancies were discussed to reach consensus. In case no consensus was reached, the senior author (M.W.S.) was consulted. If in the first-round inclusion or exclusion criteria could not be assessed from the title and abstract, the study was included for the full-text round. Inclusion- and exclusion criteria are shown in Table 2.

Quality assessment

All full-text selected articles were independently scored by two authors (J.H. and M.R.). The articles by Hellinga et al. were scored by the second author (M.R.) and an independent epidemiologist to avoid a conflict of interest.^{10,11} We used the “Quality Assessment Tool for Case Series Studies” from the National Institute of Health. (NIH; <https://www.nhlbi.nih.gov/health-pro/guidelines/in-develop/cardiовascular-risk-reduction/tools/case-control>) This tool is based on nine criteria with binary options (“Yes” or “No”) (Figure 1). Follow-up of at least 12 months was regarded adequate, in case of a shorter follow-up, this criterion was answered with “no”. We determined the final score based on the number of times “yes” was marked. A final score of less or equal than 4 times “yes” indicated a “poor” quality, 5-7 times “yes” “fair” quality and 8-9 times “yes” “good” quality. Discrepancies were handled as described above for both the title-abstract and full-text round. Cohen’s kappa was determined to measure the agreement of the quality assessment score between the two authors.

Data collection

Data collection was performed by the first author (J.H.) and cross-checked by the second author (M.R.). We extracted the age, sex, length of follow-up, indication for resection, type of resection, complications, and postoperative sexual function. The

Figure 1. Results of quality assessment

number of complications was extracted as an absolute number since the number of complications per patient was mostly not reported. In case the number of patients with complications was also reported, this percentage was also collected. Complications were categorized in reconstruction site complications and other complications. All reconstruction site complications were grouped by donor site and recipient site. The complications were defined as minor and major, based on the Clavien-Dindo classification, in which minor complications required no intervention or only pharmacological treatment and major complications required surgical intervention.¹²

Analysis

Data on LP flap and VRAM flap reconstruction were analyzed separately. For each complication a weighted average was calculated.

RESULTS

Literature search

The search yielded 752 citations in Pubmed and 969 citations in Embase. The reference check included ten extra results. In total, 1731 articles were included. After excluding duplicates, 1074 articles remained. No overlapping subjects were found between studies. After title, abstract and full-text selection 55 articles remained for quality assessment. The flowchart of the selection procedure is shown in Figure 2.

Quality assessment

The interrater agreement on the quality assessment score was substantial with an overall agreement of 87.3% (48 out of 55; $\kappa = 0.758$; $p = 0.000$).¹³ Results of the quality assessment are shown in Figure 1 and the overall score of each article is shown in Appendices A and C. The majority of the studies reached a final score of fair ($n=37$; 67.3%). Fourteen studies (25.5%) scored good and four studies (7.3%) scored poor. Overall, most studies clearly stated their study question ($n=51$; 92.7%), and results ($n=50$; 90.9%). The most frequently not reported item was question 3 “Were the cases consecutive?” ($n=42$; 76.4%).

Study characteristics

LP reconstruction

Sixteen out of the 55 articles described the application of the LP flap for reconstructions. Yii et al. were the first in 1996 to report on reconstruction using the LP flap.¹⁴ All but three of these studies are case series.¹⁴⁻²⁶ Only Negosanti et al., Confalonieri et al. and Thiele et al. reported a case control study in which a reconstruction with LP flaps was compared with other flaps.^{18,27,28} About half of the studies (56.3%) were small studies (<20 patients), the largest was that of Confalonieri

Figure 2. Flowchart of study selection procedure

et al. which included 106 patients.^{14,18,20-22,24,26-28} In 62.5% of the studies, only females were included.^{14,15,17-19,21,23,25-27} Mean age of the subjects varied between 50.3 years and 79 years.^{21,22} Length of follow-up was reported in 56.3% of the studies and varied between a mean of 10 and 84 months (details in Appendix A).^{17,18}

VRAM reconstruction

A total of 39 articles described the use of the VRAM flap for reconstruction. The first study on VRAM reconstruction was reported in 1989 by Kroll et al.²⁹ Most studies were case series (64.1%), 33.3% were case control studies in which the VRAM flap was compared with primary closure or other flaps, and one randomized clinical trial was reported.³⁰ Most studies (53.8%) were small (<20 subjects), the largest study group consisted of 114 patients.³¹ All but one of the studies reported the mean age of the patients, and age varied between 45 and 70.6 years.^{29,32,33} Length of follow-up varied between a median of nine months and a mean of 54 months. Seventeen studies (43.6%) did not (completely) report their length of follow-up (details in Appendix C).^{5,25,33-47}

Table 3. Summary of indication for resection – LP studies

Reason for resection	Rate [%]
Vulvar/vaginal cancer	77.0
Vulvar dysplasia	10.6
Colorectal cancer	2.7
Anal cancer	1.9
Melanoma	1.5
Benign colorectal disease	1.0
Hidradenitis	0.8
Gender reassignment/pseudohermaphroditism	0.6
Miscellaneous	3.8

LP: lotus petal

Table 4. Summary of type of resection – LP studies

Type of resection	Rate [%]
Total vulvectomy	40.8
(Vulvo)perineal resection	22.4
Partial vulvectomy	13.5
Extirpative surgery	12.6
APE	4.1
Miscellaneous	6.6

APE: abdominoperineal excision, LP: lotus petal

Resection characteristics

LP reconstruction

The main indication for resection in articles where LP reconstruction was performed, were vulvar/vaginal cancer (77.0%) and vulvar dysplasia (10.6%). Resection of colorectal or anal cancer was only in 4.6% of the cases indication for reconstruction (Table 3; details in Appendix A). In most cases a total (40.8%) or partial (13.5%) vulvectomy was performed. Kim et al. did not report the exact type of resection and Argenta et al. only reported that extirpative surgery was performed (Table 4; details in Appendix A).^{15,22}

VRAM reconstruction

The main indication for resection preceding VRAM reconstruction, was colorectal cancer (54.3%). Anal cancer was the indication for resection in 15.5% of the cases, uterine or cervical cancer in 9.6% and vulvar or vaginal cancer in 7.0% of the cases (Table 5; details in Appendix C). Three studies did not report the indication for resection.^{29,48,49} The main types of resection performed were an abdominoperineal excision (APE) (52.7%) or total exenteration (13.4%) (Table 6; details in Appendix C). Four studies did not report the type of resection performed.^{38,39,49,50}

Table 5. Summary of indication for resection – VRAM studies

Reason for resection	Rate [%]
Colorectal cancer	54.3
Anal cancer	15.5
Uterine/cervical cancer	9.6
Vulvar/vaginal cancer	7.0
Anorectal cancer	2.4
Urogenital cancer	1.8
Urethra/bladder cancer	1.5
Sarcoma	1.5
Prostatic cancer	1.4
Benign colorectal disease	1.3
Miscellaneous	3.8

VRAM: vertical rectus abdominis myocutaneous

Table 6. Summary of type of resection – VRAM studies

Type of resection	Rate [%]
APE	52.7
Total exenteration	13.4
Exenteration	7.9
Posterior exenteration	7.3
Anterior exenteration	3.9
Extirpative surgery	3.7
Sacral resection	1.3
Groin dissection	1.3
Miscellaneous	8.5

APE: abdominoperineal excision, VRAM: vertical rectus abdominis myocutaneous

Complications of reconstruction site

LP reconstruction

The number of patients with any reconstruction site complication following reconstruction with the LP flap varies from 0.0% to 69.9%.^{11,14,16,22} All studies on reconstruction with the LP flap reported whether there were complications in either the donor or recipient site, or not. Most complications occurred at the recipient site (26.0% versus 4.5%). The donor site showed mostly minor complications (3.5% versus 1.0% major complications). Main indication for intervention at the donor site was wound dehiscence (60%). For the recipient site also more minor than major complications were reported (17.8% versus 8.2%). Three studies reported no recipient site complications.^{14,16,22} Partial flap loss and partial wound dehiscence accounted for most of the reported complications (5.0% resp. 3.5%). Complete flap loss only occurred in 0.4% of the cases (Table 7; details Appendix B). Figure 3 shows the minor and major complication rates of both the donor and recipient site.

Figure 3. Reconstruction site specific complications

Table 7. Summary of reconstruction site complications – LP studies

Donor site	Rate (%)	Recipient site	Rate (%)
Wound dehiscence	0.8	Partial flap loss	5.0
Not specified	3.1	Partial wound dehiscence	3.5
Miscellaneous	0.6	Seroma	1.0
		Stenosis	0.6
		Complete flap loss	0.4
		Not specified	13.6
		Miscellaneous	1.9

LP: lotus petal

VRAM reconstruction

The reported percentage of patients with any reconstruction site complication showed a wide variance from 0.0% to 85.7%.^{51,52} Most (59.0%) studies only reported the total amount of reconstruction site complications, and not the complications per patient. Twice as many recipient site complications, following reconstruction with the VRAM flap, were reported compared to donor site complications (39.4% versus 19.3%). In eight (20.5%) studies, no donor site complications occurred.^{41,49,52-56} Eight (20.5%) studies did not distinguish between minor and major complications for the donor site.^{5,7,30,31,39,57-59} In the remaining studies, minor complications were reported more often than major complications (15.2% versus 2.6%). Partial wound dehiscence and wound infection were the most commonly reported complications of the donor site (7.7% resp. 4.0%). In the study of Sheckter et al. no recipient

Table 8. Summary of reconstruction site complications – VRAM studies

Donor site	Rate (%)	Recipient site	Rate (%)
Partial wound dehiscence	7.7	Partial wound dehiscence	10.1
Wound infection	4.0	Abscess	4.5
Incisional herniation	2.2	Partial flap loss	4.3
Miscellaneous	5.1	Wound infection	3.2
		Large wound dehiscence	2.4
		Complete flap loss	2.2
		Stenosis	1.6
		Delayed healing	1.3
		Fluid collection	1.3
		Seroma	1.3
		Superficial epidermiolysis	0.9
		Urethral/urethric damage	0.9
		Miscellaneous	5.0

VRAM: vertical rectus abdominis myocutaneous

site complications occurred.⁴⁹ Nine (23.1%) studies did not make the distinction between minor and major recipient site complications.^{30,31,39,42,47,54,57-59} Minor complications were reported in 28.4% of the cases and major complications in 8.7% of the cases. The most common complication of the recipient site was partial wound dehiscence (10.1%). Also abscess formation (4.5%) and partial flap loss (4.3%) occurred relatively often. Complete flap loss was reported in 2.2% of the cases (Table 8; details in Appendix D). Figure 3 shows the minor and major complication rates of both the donor and recipient site.

General complications

LP reconstruction

Two studies reported that no general complications occurred.^{14,28} Complications reported in other studies were urinary tract infection (1.3%), deep venous thrombosis (1.3%) and cerebrovascular incident (1.3%) (details in Appendix B).

VRAM reconstruction

The most common general complications following VRAM flap reconstruction were urinary tract infection (3.8%), small bowel obstruction (3.2%), parastomal herniation (1.9%) and deep venous thrombosis (1.7%) (details in Appendix D).

Sexual function

LP reconstruction

Two studies reported the sexual outcome following LP flap reconstruction.^{17,25} The study by Ragoowansi et al. reported that 17% of the patients had returned to sexual activity in 6 to 9 months following the reconstruction.²⁵ The other study reported that all “sexual active patients” did not report any problems, however they did not mention the rate of sexual active patients.¹⁷

VRAM reconstruction

Eight studies reported details on postoperative sexual function.^{36,39,44,47,55,60-62} Three of the studies used a questionnaire and one study performed a postoperative interview.^{44,47,61,62} Rates of return to sexual activity ranged from 26.7-50.0%. However, Casey et al. reported that 18 of the 35 patients were sexually active preoperative and 17 of them were remained active postoperative.³⁹ The trend showed that younger patients returned more often to sexual activity, however most patients reported a lower quality of their sexual activity. However, Cortinovis et al. reported a higher satisfaction with their sexual activity postoperative.⁶²

DISCUSSION

Summary of evidence

Vulvoperineal defects have often been closed with VRAM flaps, however over the last years the LP flap is gaining popularity. Therefore, the aim of this systematic review was to compare the postoperative complications of the LP flap procedure and the VRAM flap procedure for vulvoperineal reconstruction by performing a thorough analysis of literature. Our analysis suggest that patients following the LP flap procedure experience a relative lower number of postoperative reconstruction site complications compared to VRAM flap procedure.

While the LP flap was only described in 1996 by Yii and Niranjani, the VRAM flap was first described for the reconstruction of perineal wounds in 1984 by Shukla et al.^{14,63} However, the first articles included in this review on the VRAM flap originate from 1989.²⁹ The resulting shorter period of use of LP reconstructions compared to VRAM reconstructions is a clear confounder in our search results. The search included 14 articles on LP flap reconstruction, mainly case series and small study populations, whereas it yielded 39 VRAM flap reconstruction articles, both case series and case controls, and one randomized clinical trial. Our quality assessment scores also showed a lower quality of the LP flap articles compared to the VRAM flap articles. The difference in included articles for both groups and as a result the difference in quality of the articles, may have affected the results of our review.

The indication for resection and type of resection preceding LP flap reconstruction is mainly a gynecological tumor (87.6%) that needed total or partial vulvectomy (54.3%). Colorectal or anal tumors are preceding LP reconstruction only in 4.6% of the patients. In patients of the VRAM flap group the picture is different; 69.8% had a colorectal or anal tumor and 16.6% a gynecological tumor. APE or any type of exenteration was performed in 85.2% of the cases. The difference in indication for and type of resection varies between both groups of patients. This may have caused a selection bias in the application of the flaps. This systematic review revealed that the VRAM flap is

more often used following resection of extensive colorectal tumors. This may give the impression that an LP reconstruction is not always feasible for such defects and that the comparison we performed in this review is not a fair one. However, we think that a more appropriate explanation for this difference is that the LP flap was initially only described for vulvar reconstruction. Our group however has very positive experience with the application of LP flaps for reconstruction in the perineal area following APE/ELAPE.^{10,64} Each flap of course has its own specific donor site complications. Therefore, when comparing different flaps, only the comparison of generic complications between both reconstruction techniques is relevant for clinical decision making. We are of the opinion that the difference in recipient sites following gynecological respectively anorectal tumor resections does not greatly influence generic donor site complication or flap complication rates. This makes comparison of those techniques, despite the different anatomical reconstruction sites, a realistic comparison.

The variance in number of patients with one or more reconstruction site complications is smaller following LP flap reconstruction compared to VRAM flap reconstruction (0.0-69.9% versus 0.0-85.7%). Both reconstruction types show higher number of recipient site complications than donor site complications. However, the percentage of recipient site complications following the LP flap procedure is less than half of that following a VRAM flap procedure. This difference is even larger for reported donor site complications. Both reconstruction procedures show more minor recipient site complications compared to major recipient site complications. The minor/major ratio is a little higher following the LP flap procedure. The types of complications are comparable, but no large wound dehiscences were reported following LP flap reconstruction. Also the total percentage of partial and complete flap loss were lower following the LP flap procedure.

Complications other than those of the reconstruction site were rare, but more frequent following VRAM flap reconstructions. These complications were mostly related to the long operation time of the resection and reconstruction (e.g. urinary tract infection, deep venous thrombosis and small bowel obstruction). No parastomal herniations were reported following LP flap reconstruction which could be explained by the low rate of colorectal resections in this group.

Sexual dysfunction was rarely reported following LP flap (12.5%) as well as VRAM flap application (20.5%).^{17,25,36,39,44,47,55,60-62} We find it surprising that there is so little research on the topic of sexual dysfunction, especially since it concerns surgery in the vulvoperineal area. We suppose that postoperative sexual activity rates could also be influenced by area of resection, either vulvar or perineal.

Limitations

As in every systematic review the quality of the available evidence greatly influenced the strength of our results. Especially the LP flap group contained only few high evidence studies with poor scores on the quality assessment. The

large variability in indication for resection and low uniformity in presenting the reconstruction site complications also undermined the quality of the results. Also the poor levels of presenting data (e.g. other complications) affected the results presented. Unfortunately, there is a lack of prospective studies. Also, a randomized controlled trial is unethical. At best a properly powered multicenter propensity matched control study may be able to reveal the differences more clearly. Therefore our conclusion should be drawn with care.

We tried to give insight in possible publication bias by drawing a funnel plot. However, more than half of the studies did not report the number of patients with one or more complications. In these studies, the complication rate as percentage of included patients cannot be determined. As a consequence, studies with a complication rate of zero would be overrepresented in a funnel plot. Since the complication rate might depend on reconstruction type, a funnel plot would provide an incorrect representation of publication bias, or even introduce selection bias. Therefore, we decided not to include it in this paper.

We aimed to reduce the language bias by also including Dutch and German language articles, besides English language articles. It is thought that positive results will mainly be reported in English language journals. However, the evidence to support this small effect is weak.⁶⁵ Unfortunately, there were no studies available that compared both reconstruction procedures in one study and therefore we were not able to perform a meta-analysis.

Conclusions

This systematic review demonstrated lower complication rates in both the donor site and the recipient site, following the LP flap procedure compared to the VRAM flap procedure. This knowledge could guide the plastic surgeon during counseling and to take the decision for either reconstruction technique. In case in which both reconstruction procedures can be applied, the LP flap procedure should be considered owing to the relatively low complication rates.

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Appendix A. Characteristics of included studies with LP flaps

Reference	Study design	No. of patients (no. of women)	Age (years)		Length of follow-up (months)		
			Mean	Range	Mean	Range	
Argenta et al., 2013 ¹⁵	Case series	59 (59)	59	24-89	NR	NR	
Bodin et al., 2015 ¹⁶	Case series	6 (2)	61.5	47-72	20.5	4-39	
Buda et al., 2012 ¹⁷	Case series	22 (22)	64	44-78	10	2-16	
Confalonieri et al., 2017 ¹⁸	Case control	106 (106)	68.6	43-90	84	6-180	
Franchelli et al., 2009 ¹⁹	Case series	33 (33)	66†	56-88	NR	NR	
Hashimoto et al., 2001 ²⁰	Case series	10 (9)	59.9	19-82	NR	NR	
Hellinga et al., 2018 ¹¹	Case series	93 (83)	68.2†	18.9-91.9	26.3†	5.5-119.7	
Herraiz Roda et al., 2016 ²¹	Case series	9 (9)	79	65-93	NR	NR-3	
Kim et al., 2014 ²²	Case series	11 (10)	50.27	8-75	NR	3-84	
Misani et al., 2011 ²³	Case series	41 (41)	72	53-87	15	4-42	
Negosanti et al., 2015 ²⁷	Case control#	17 (17)	71.8	39-86	NR	NR	
Pantelides et al., 2013 ²⁴	Case series	7 (4)	59	38-77	24	2-57	
Ragoowansi et al., 2004 ²⁵	Case series	40 (40)	57	45-76	16	3-48	
Sawada et al., 2004 ²⁶	Case series	5 (5)	64	56-72	18	7-32	
Thiele et al., 2020 ²⁸	Case control#	12 (5)	66.2	49-83	16	4-31	
Yii et al., 1996 ¹⁴	Case series	8 (8)	58.6	27-76	NR	3-NR	

control group are other flaps, † median

APR: abdominoperineal resection, LP: lotus petal, NR: not reported

	Indication for resection	Type of resection	Quality assessment score
	Vulvar/vaginal cancer (n=39); vulvar dysplasia (n=12); benign colorectal disease (n=5); hidradenitis (n=3)	Extirpative surgery (n=59)	Good
	Vulvar dysplasia (n=1); colorectal cancer (n=3); prostate cancer (n=1); necrotizing fasciitis (n=1)	APR (n=3); resection of colon or rectum (n=1); debridement (n=1); perianal resection (n=1)	Fair
	Vulvar/vaginal cancer (n=20); introital stenosis (n=2)	Total vulvectomy (n=14); partial vulvectomy (n=3); (vulvo)perineal resection (n=5)	Fair
	Vulvar/vaginal cancer (n=84); vulvar dysplasia (n=17); melanoma (n=3); other (n=2)	Total vulvectomy (n=83); other (n=23)	Good
	Vulvar/vaginal cancer (n=31); vulvar dysplasia (n=1); melanoma (n=1)	Total vulvectomy (n=17); partial vulvectomy (n=16)	Fair
	Vulvar/vaginal cancer (n=7); vulvar dysplasia (n=1); anal cancer (n=1); melanoma (n=1)	Total vulvectomy (n=3); partial vulvectomy (n=7)	Poor
	Vulvar/vaginal cancer (n=80); vulvar dysplasia (n=5); fistula (n=7); herniation (n=1)	(vulvo)perineal resection (n=93)	Fair
	Vulvar/vaginal cancer (n=8); vulvar dysplasia (n=1)	Total vulvectomy (n=9)	Fair
	Vulvar/vaginal cancer (n=5); vulvar dysplasia (n=3); gender reassignment/pseudohermaphroditism (n=3)	NR	Poor
	Vulvar/vaginal cancer (n=37); vulvar dysplasia (n=4)	Total vulvectomy (n=31); partial vulvectomy (n=4); (vulvo)perineal resection (n=6)	Fair
	Vulvar/vaginal cancer (n=10); vulvar dysplasia (n=5); melanoma (n=1); sarcoma (n=1)	Total vulvectomy (n=11); partial vulvectomy (n=6)	Fair
	Colorectal cancer (n=3); anal cancer (n=4)	(vulvo)perineal resection (n=1); APR (n=5); posterior exenteration (n=1)	Fair
	Vulvar/vaginal cancer (n=38); hidradenitis (n=1); recto-vaginal fistula (n=1)	Total vulvectomy (n=16); partial vulvectomy (n=22); excision fistula (n=1); excision hidradenitis (n=1)	Fair
	Vulvar vaginal cancer (n=3); vulvar dysplasia (n=1); melanoma (n=1)	Total vulvectomy (n=3); partial vulvectomy (n=2)	Fair
	Colorectal cancer (n=7); anal cancer (n=4); other (n=1)	APR (n=11); other (n=1)	Good
	Vulvar/vaginal cancer (n=7); vaginal stenosis (n=1)	Total vulvectomy (n=4); partial vulvectomy (n=3); release of stenosis (n=1)	Poor

Appendix B. Complications of included studies with LP flaps

Reference	Total number of complications (% patients with complications)*	Complications donor site			
		Minor	Major	Specification	
Argenta et al., 2013 ¹⁵	21 (NR)	0	0	None	
Bodin et al., 2015 ¹⁶	0 (0.0)	0	0	None	
Buda et al., 2012 ¹⁷	2 (9.1)	0	0	None	
Confalonieri et al., 2017 ¹⁸	14 (13)	0	0	None	
Franchelli et al., 2009 ¹⁹	7 (21.2)	0	0	None	
Hashimoto et al., 2001 ²⁰	2 (20.0)	0	1	Wound breakdown (n=1)	
Hellinga et al., 2018 ¹¹	65 (69.9)	15	0	Not specified (n=15)	
Herraiz Roda et al., 2016 ²¹	3 (NR)	0	0	None	
Kim et al., 2014 ²²	0 (0.0)	0	0	None	
Misani et al., 2011 ²³	4 (9.8)	0	2	Wound breakdown (n=2)	
Negosanti et al., 2015 ²⁷	3 (17.6)	0	0	None	
Pantelides et al., 2013 ²⁴	2 (28.6)	0	1	Hematoma (n=1)	
Ragoowansi et al., 2004 ²⁵	8 (15.0)	1	0	Hypertrophic scar (n=1)	
Sawada et al., 2004 ²⁶	3 (40.0)	1	0	Wound infection (n=1)	
Thiele et al., 2020 ²⁸	8 (66.7)	0	1	Partial wound dehiscence (n=1)	
Yii et al., 1996 ¹⁴	0 (0.0)	0	0	None	

* total number of complications of the reconstruction site reported and percentage of patients with one or more complications

LP: lotus petal, NR: not reported

	Complications recipient site			General complications
	Minor	Major	Specification	
	14	7	Partial flap loss (n=7); partial wound dehiscence (n=12); stenosis (n=2)	Deep venous thrombosis (n=1)
	0	0	None	NR
	1	1	Partial flap loss (n=2)	NR
	NR	NR	Partial flap loss (n=5); partial wound dehiscence (n=7); wound infection (n=2)	NR
	6	1	Partial flap loss (n=2); seroma (n=5)	NR
	0	1	Hematoma (n=1)	NR
	48	17	Not specified (n=65)	NR
	3	0	Partial wound dehiscence (n=2); stenosis (n=1)	Urinary tract infection (n=1); cerebrovascular accident (n=1)
	0	0	None	NR
	2	0	Partial flap loss (n=1); complete flap loss (n=1)	NR
	0	3	Partial wound dehiscence (n=3)	NR
	0	1	Delayed healing (n=1)	NR
	5	2	Partial flap loss (n=6); complete flap loss (n=1)	NR
	2	0	Partial flap loss (n=1); wound infection (n=1)	NR
	2	5	Partial wound dehiscence (n=3); wound infection (n=2); delayed healing (n=1); abscess (n=1)	None
	0	0	None	None

Appendix C. Characteristics of included studies with VRAM flaps

Reference	Study design	No. of patients (no. of women)	Age (years)		Length of follow-up (months)		
			Mean	Range	Mean	Range	
Bakx et al., 2004 ⁶⁶	Case series	37 (22)	58†	28-85	19†	1-72	
Barker JA et al., 2013 ³⁴	Case control*	12 (7)	69	50-84	NR	6-50	
Barker T et al., 2013 ³⁵	Case series	55 (24)	65†	38-84	NR	NR-30 days	
Bell et al., 2005 ³⁶	Case series	31 (18)	55†	30-77	9†	1-27	
Berger et al., 2012 ³⁷	Case series	46 (46)	53	30.4-77.7	NR	NR	
Buchel et al., 2004 ³⁸	Case series	73 (47)	56.1	28-79	NR	NR	
Butler et al., 2008 ⁷	Case control*	35 (28)	54.3	13.8‡	3.2 yrs	2.3 yrs‡	
Casey III et al., 2004 ³⁹	Case control#	41 (41)	54.7	13.1‡	28.9§	NR	
Chessin et al., 2005 ⁵	Case control*	19 (17)	56.5	32-74	NR	NR	
Chokshi et al., 2013 ⁴⁸	Case control*	17 (14)	62†	38-72	11.5	1-60	
Combs et al., 2014 ⁶⁷	Case control#	49 (26)	54.7	11.7‡	25.6	29.3‡	
Cortinovis et al., 2018 ⁶	Case series	16 (16)	56†	29-75	24†	3-99	
Creagh et al., 2012 ⁴⁰	Case series	37 (23)	60†	33-86	54	3-108	
Erdmann et al., 1995 ⁴¹	Case series	12 (8)	48.4	19-72	18.7	NR	

	Indication for resection	Type of resection	Quality assessment score
	Colorectal cancer (n=16); anal cancer (n=9); persisting wound (n=4); unknown (n=8)	APR (n=7); exenteration (n=3); sacral resection (n=13); soft tissue resection (n=4); groin dissection (n=6); secondary wound closure (n=4)	Fair
	Colorectal cancer (n=12)	APR (n=12)	Good
	Colorectal cancer (n=40); anal cancer (n=15)	APR (n=55)	Good
	Colorectal cancer (n=11); anal cancer (n=17); giant generated condyloma (n=1); perineal herniation (n=1); degenerative haemartoma (n=1)	APR (n=30); perineal herniation repair (n=1)	Fair
	Vulvar/vaginal cancer (n=23); uterine/cervical cancer (n=23)	Total exenteration (n=35); anterior exenteration (n=7); posterior exenteration (n=4)	Fair
	Vulvar/vaginal cancer (n=6); uterine/cervical cancer (n=6); colorectal cancer (n=40); anal cancer (n=9); benign colorectal disease (n=3); sarcoma (n=4); melanoma (n=1); radiation necrosis (n=4)	NR	Fair
	Colorectal cancer (n=30); anal cancer (n=5)	APR (n=35)	Good
	Anorectal cancer (n=23); urogenital cancer (n=18)	NR	Fair
	Colorectal cancer (n=12); anal cancer (n=7)	APR (n=19) of which 15 combined with vaginectomy	Fair
	NR	Total exenteration (n=17)	Fair
	Vulvar/vaginal cancer (n=4); uterine/cervical cancer (n=8); colorectal cancer (n=16); anal cancer (n=7); prostate cancer (n=1); urogenital cancer (n=1); squamous cell carcinoma (n=4); benign colorectal disease (n=1); sarcoma (n=6); presacral abscess (n=1)	APR (n=17); exenteration (n=16); pelvic resection (n=6); (vulvo)perineal resection (n=3); groin dissection (n=7)	Good
	Vulvar/vaginal cancer (n=1); uterine/cervical cancer (n=3); colorectal cancer (n=7); anal cancer (n=2); melanoma (n=2); botryoid rhabdomyosarcoma (n=1)	Partial vulvectomy (n=13); total vulvectomy (n=3); anterior exenteration (n=1); posterior exenteration (n=10)	Good
	Colorectal cancer (n=37)	Extirpative surgery (n=37)	Good
	Vulvar/vaginal cancer (n=1); urethra/bladder cancer (n=1); colorectal cancer (n=6); benign colorectal disease (n=4)	APR (n=7); exenteration (n=1); resection of colon or rectum (n=3); cystectomy (n=1)	Fair

Appendix C. Continued

Reference	Study design	No. of patients (no. of women)	Age (years)		Length of follow-up (months)		
			Mean	Range	Mean	Range	
Gupta et al., 2020 ⁵⁸	Case series	5 (5)	52.2	41-71	NR	0-20	
Haas, de et al., 1995 ⁴²	Case series	26 (17)	52	29-74	22	NR	
Hardt et al., 2016 ⁵²	Case control*	7 (7)§	56†§	36-74§	27.3/11.7~	20.9-92.1 /2.0-35.6~	
Haverland et al., 2020 ⁵⁶	Case series	6 (4)	69.2	57-79	9.2†	5-12	
Hinojosa et al., 2009 ⁴²	Case series	15 (8)	61	9‡	NR	NR	
Holman et al., 2013 ⁴⁴	Case series	51 (41)	62.2	32.4-86.8	NR	NR	
Horch et al., 2014 ⁵⁷	Case control*	100 (38)	63.35	12.26‡	26.3	20.45‡	
Houvenaeghel et al., 2005 ⁴⁵	Case series	46 (41)	52.7	26-72	NR	NR	
Jain et al., 1997 ³²	Case series	15 (12)	45	16‡	24.3	6-58	
Kouraklis et al., 2002 ³³	Case series	11 (NR)	70.6	63-79	NR	NR-24	
Kroll et al., 1989 ²⁹	Case series	7 (NR)	NR	NR	NR	NR	
Loessin et al., 1995 ⁵⁰	Case series	15 (3)	52	26-83	32†	6-56	
Nelson et al., 2009 ³¹	Case control#	114 (72)	58	12‡	24.2/18.0†	20.6‡	

	Indication for resection	Type of resection	Quality assessment score
	Vulvar/vaginal cancer (n=1); uterine/cervical cancer (n=2); melanoma (n=1); vaginal stenosis (n=1)	Partial vulvectomy (n=1); total vulvectomy (n=1); exenteration (n=3);	Fair
	Urethra/bladder cancer (n=2); colorectal cancer (n=12); anal cancer (n=7); prostate cancer (n=1); anorectal cancer (n=1); sarcoma (n=3)	Exenteration (n=26)	Fair
	Anal cancer (n=7)	APR (n=7)	Fair
	Vulvar/vaginal cancer (n=2); colorectal cancer (n=2); vesicovaginal fistel (n=1); complex pelvic organ prolapse (n=1)	Total vulvectomy (n=1); APR (n=2); anterior exenteration (n=1); posterior exenteration (n=1); vesicovaginal fistula repair (n=1)	Fair
	Colorectal cancer (n=14); anal cancer (n=1)	APR (n=15)	Fair
	Colorectal cancer (n=48); anal cancer (n=3)	APR (n=34); abdominosacral resection (n=11); debulking (n=6)	Fair
	Vulvar/vaginal cancer (n=5); urethra/bladder cancer (n=1); uterine/cervical cancer (n=2); colorectal cancer (n=73); anal cancer (n=15); prostate cancer (n=3); melanoma (n=1)	APR (n=86); total exenteration (n=12); resection of colon or rectum (n=2)	Good
	Vulvar/vaginalcancer (n=2); uterine/cervical cancer (n=24); colorectal cancer (n=7); anal cancer (n=11); muller blastoma (n=1); melanoma (n=1)	Total vulvectomy (n=1); APR (n=11); total exenteration (n=11); anterior exenteration (n=11); posterior exenteration (n=10); total colpohysterectomy (n=1); atypical resection (n=1)	Fair
	Vulvar/vaginalcancer (n=2); uterine/cervical cancer (n=1); colorectal cancer (n=10); anal cancer (n=1); benign colorectal disease (n=1)	APR (n=5); total exenteration (n=1); posterior exenteration (n=9)	Fair
	Colorectal cancer (n=8); gynaecologic (n=3)	Radical pelvic surgery (n=11)	Fair
	NR	APR (n=7)	Poor
	Colorectal cancer (n=7); anal cancer (n=1); prostate cancer (n=1); benign colorectal disease (n=4); sarcoma (n=2)	NR	Good
	Vulvar/vaginal cancer (n=2); urethra/bladder cancer (n=10); colorectal cancer (n=75); anal cancer (n=16); prostate cancer (n=9); unknown (n=2)	APR (n=46); exenteration (n=2); total exenteration (n=23); anterior exenteration (n=8); posterior exenteration (n=35)	Good

Appendix C. Continued

Reference	Study design	No. of patients (no. of women)	Age (years)		Length of follow-up (months)		
			Mean	Range	Mean	Range	
Pang et al., 2014 ⁶⁸	Case control#	9 (3)	53.1	12.3‡	178.6days	45.1 days‡	
Peacock et al., 2012 ⁵⁴	Case control (met mesh)	5 (1)	68†	48-74	29	23-35	
Petrie et al., 2009 ⁴⁶	Case series	14 (9)	63.9	47-81	9†	NR	
Pursell et al., 1990 ⁶⁰	Case series	22 (NR)	49.9	24-82	16.3	3-36	
Sheckter et al., 2016 ⁴⁹	Case control*#	9 (29§)	57.94§	NR	421 days§	322 days‡§	
Shepherd et al., 1990 ⁵⁵	Case series	16 (16)	55	25-77	29†	4-72	
Smith et al., 1998 ⁴⁷	Case series	22 (NR)	52†	14.2	NR	NR	
Stein et al., 2019 ⁵⁹	Case control#	61 (47)	62.4	11.6‡	NR	NR	
Tei et al., 2003 ⁶¹	Case series	14 (13)	65.5†	45-78	14.5†	3-41	
Touny et al., 2014 ³⁰	RCT	30 (9)	53.5†	26-68	25§	6-48§	

* control group is primary closure, # control group are other flaps, † median, ‡ standard deviation, § value for all study patients (no specific value for only VRAM-reconstruction patients available), ~ survivor versus non-survivor group
 APR: abdominoperineal resection; NR: not reported; RCT: randomized clinical trial; VRAM: vertical rectus abdominis myocutaneous

	Indication for resection	Type of resection	Quality assessment score
	Colorectal cancer (n=6); anorectal cancer (n=2); sarcoma (n=1)	APR (n=9)	Fair
	Colorectal cancer (n=5)	APR (n=5)	Good
	Colorectal cancer (n=10); anal cancer (n=4)	APR (n=14)	Fair
	Vulvar/vaginal cancer (n=4); uterine/cervical cancer (n=17); colorectal cancer (n=1)	Total exenteration (n=18); anterior exenteration (n=3); posterior exenteration (n=1)	Fair
	Colorectal cancer (n=27); anal cancer (n=17); benign colorectal disease (n=4); sarcoma (n=1); melanoma (n=1); hamartoma (n=1); traumatic perineum (n=1)§	APR (n=51)§	Fair
	Vulvar/vaginal cancer (n=16)	Partial vulvectomy (n=3); total vulvectomy (n=6); total exenteration (n=1); anterior exenteration (n=4); posterior exenteration (n=2)	Fair
	Vulvar/vaginal cancer (n=2); urethra/bladder cancer (n=2); uterine/cervical cancer (n=17); colorectal cancer (n=1)	Total exenteration (n=16); anterior exenteration (n=4); posterior exenteration (n=1); excision vaginal stenosis (n=1)	Fair
	Vulvar/vaginal cancer (n=5); uterine/cervical cancer (n=1); colorectal cancer (n=42); anal cancer (n=110); benign colorectal disease (n=1); perianal m. paget (n=1)	APR (n=53); exenteration (n=18)	Fair
	Anal cancer (n=14)	APR (n=14)	Fair
	Colorectal cancer (n=30)	APR (n=30)	Good

Appendix D. Complications of included studies with VRAM flaps

Reference	Total number of complications (% patients with complications)*	Complications donor site			
		Minor	Major	Specification	
Bakx et al., 2004 ⁶⁶	15 (NR)	5	2	Wound infection (n=2); partial wound dehiscence (n=1); incisional herniation (n=4)	
Barker JA et al., 2013 ³⁴	8 (50.0)	1	0	Incisional herniation (n=1)	
Barker T et al., 2013 ³⁵	15 (27.3)	0	1	Wound infection (n=1)	
Bell et al., 2005 ³⁶	10 (32.3)	3	0	Weakness abdominal wall (n=2); abscess (n=1)	
Berger et al., 2012 ³⁷	45 (NR)	22	0	Partial wound dehiscence (n=22)	
Buchel et al., 2004 ³⁸	14 (NR)	2	0	Wound infection (n=2)	
Butler et al., 2008 ⁷	27 (NR)	NR	NR	Partial wound dehiscence (n=6); incisional herniation (n=2); delayed healing (n=1)	
Casey III et al., 2004 ³⁹	13 (31.7)	NR	NR	Unknown (n=4)	
Chessin et al., 2005 ⁵	5 (NR)	NR	NR	Wound infection (n=2)	
Chokshi et al., 2013 ⁴⁸	35 (NR)	13	0	Wound infection (n=7); partial wound dehiscence (n=6)	
Combs et al., 2014 ⁶⁸	34 (NR)	14	1	Partial wound dehiscence (n=13); large wound dehiscence (n=2)	
Cortinovis et al., 2018 ⁶²	3 (12.5)	2	1	Partial wound dehiscence (n=1); incisional herniation (n=1); abscess (n=1)	

	Complications recipient site			General complications
	Minor	Major	Specification	
	7	1	Wound infection (n=1); partial wound dehiscence (n=2); seroma (n=4); ongoing bleeding (n=1)	Small bowel obstruction (n=1); urostomy necrosis (n=1)
	5	2	Partial wound dehiscence (n=3); partial flap loss (n=2); complete flap loss (n=1); sinus formation (n=1)	Metastasis (n=2); retracted stoma (n=1); parastomal herniation (n=1)
	11	3	Wound infection (n=1); partial wound dehiscence (n=5); large wound dehiscence (n=1); partial flap loss (n=2); complete flap loss (n=2); hematoma (n=1); excess granulation (n=1); sinus formation (n=1)	Myocardial infarction (n=1)
	3	4	Flap disunion (n=1); partial flap loss (n=3); stenosis (n=2); scarring of vaginal wall (n=1)	Urine retention (n=2); urine fistula (n=1); shock (n=2)
	22	1	Partial wound dehiscence (n=3); partial flap loss (n=2); complete flap loss (n=1); abscess (n=14); stenosis (n=3)	NR
	11	1	Partial wound dehiscence (n=2); partial flap loss (n=7); complete flap loss (n=1); abscess (n=2)	Small bowel obstruction (n=1); retained drain (n=1)
	14	4	Partial wound dehiscence (n=9); large wound dehiscence (n=3); complete flap loss (n=1); abscess (n=3); perineal herniation (n=2)	Parastomal herniation (n=4)
	NR	NR	Vaginal fistula (n=1); flap loss or dehiscence (n=5); unknown (n=3)	NR
	2	1	Wound cellulitis (n=1); partial wound dehiscence (n=1); abscess (n=1)	Deep venous thrombosis (n=2); small bowel obstruction (n=3); unknown (n=1)
	35	1	Large wound dehiscence (n=7); complete flap loss (n=2); abscess (n=10); enterocutaneous fistula (n=3); ventral herniation (n=14)	Deep venous thrombosis (n=2); urinary tract infection (n=3); small bowel obstruction (n=1)
	9	10	Partial wound dehiscence (n=12); large wound dehiscence (n=1); partial flap loss (n=4); complete flap loss (n=2)	NR
	0	1	Stenosis (n=1)	Parastomal herniation (n=1); pelvic abscess (n=2); atelectasis (n=1); pulmonary inflammation (n=1); ileovaginal fistula (n=1); urinary retention (n=1); sepsis (n=1); intestinal fistula (n=1); urethral stenosis (n=1)

Appendix D. Continued

Reference	Total number of complications (% patients with complications)*	Complications donor site			
		Minor	Major	Specification	
Erdmann et al., 1995 ⁴¹	2 (16.7)	0	0	None	
Espinosa-de-los-Monteros et al., 2016 ⁵¹	0 (0.0)	0	0	None	
Gupta et al., 2020 ⁵⁸	3 (60.0)	NR	NR	Partial wound dehiscence (n=1); wound infection (n=1)	
Haas, de et al., 1995 ⁴²	16 (NR)	2	1	Wound infection (n=2); incisional herniation (n=1)	
Hardt et al., 2016 ⁵²	7 (85.7)	0	0	None	
Haverland et al., 2020 ⁵⁶	1 (16.7)	0	0	None	
Hinojosa et al., 2009 ⁴³	10 (NR)	3	0	Partial wound dehiscence (n=3)	
Holman et al., 2013 ⁴⁴	14 (NR)	NR	NR	NR	
Horch et al., 2014 ⁵⁷	17 (NR)	NR	NR	Unknown (n=6)	
Houvenaeghel et al., 2005 ⁴⁵	16 (NR)	5	1	Wound infection (n=4); incisional herniation (n=1); mesh dehiscence (n=1)	
Jain et al., 1997 ³²	6 (26.7)	1	0	Wound infection (n=1)	
Kouraklis et al., 2002 ³³	2 (NR)	1	0	Hypogastric bulge (n=1)	
Kroll et al., 1989 ²⁹	2 (28.6)	0	1	Incisional herniation (n=1)	
Loessin et al., 1995 ⁵⁰	9 (53.3)	1	0	Wound infection (n=1)	
Nelson et al., 2009 ³¹	154 (NR)	NR	NR	Wound infection (n=4); cellulitis (n=7); partial wound dehiscence (n=13); large wound dehiscence (n=3); incisional herniation (n=4); abscess (n=4); fluid collection (n=8); seroma (n=6); haematoma (n=2); other (n=8)	

	Complications recipient site			General complications
	Minor	Major	Specification	
	0	2	Partial flap loss (n=2)	NR
	0	0	NR	Shock (n=1)
	NR	NR	Rectovaginal fistula (n=1)	Deep venous thrombosis (n=2); urinary tract infection (n=4); ileus (n=7); small bowel obstruction (n=4); pneumonia (n=5)
	NR	NR	Delayed healing (n=9); partial flap loss (n=1); complete flap loss (n=2); enterocutaneous fistula (n=1)	NR
	6	1	Wound infection (n=6); partial flap loss (n=1)	NR
	0	1	Abscess (n=1)	Small bowel obstruction (n=1); pyelonephritis (n=1)
	6	1	Wound infection (n=1); partial wound dehiscence (n=5); abscess (n=1)	Urinary tract infection (n=1); ileus (n=1); ostomy ulceration (n=1)
	10	4	Partial flap loss (n=3); abscess (n=7); stenosis (n=4)	NR
	NR	NR	Complete flap loss (n=2); unknown (n=9)	NR
	5	5	Partial wound dehiscence (n=6); large wound dehiscence (n=1); partial flap loss (n=1); complete flap loss (n=1); abscess (n=1)	Major surgical (n=9); minor surgical (n=3); parietal (n=7); medical (n=5)
	3	2	Delayed healing (n=2); wound infection (n=1); partial wound dehiscence (n=1); partial flap loss (n=1)	NR
	0	1	Ongoing bleeding (n=1)	Gastrointestinal bleeding (n=1)
	1	0	Pedicle damage (n=1)	NR
	5	3	Partial flap loss (n=2); hematoma (n=1); abscess (n=1); sinus formation (n=3); urethral disruption (n=1)	NR
	NR	NR	Wound infection (n=6); cellulitis (n=5); partial wound dehiscence (n=37); large wound dehiscence (n=6); partial flap loss (n=6); complete flap loss (n=1); seroma (n=7); abscess (n=7); fluid collection (n=14); perineal herniation (n=1); other (n=5)	Urinary tract infection (n=11); parastomal herniation (n=8); small bowel obstruction (n=6); other (n=25)

Appendix D. Continued

Reference	Total number of complications (% patients with complications)*	Complications donor site			
		Minor	Major	Specification	
Pang et al., 2014 ⁶⁸	14 (NR)	0	1	Incisional herniation (n=1)	
Peacock et al., 2012 ⁵⁴	4 (NR)	0	0	None	
Petrie et al., 2009 ⁴⁶	13 (78.6)	2	0	Sinus formation (n=1); delayed healing (n=1)	
Pursell et al., 1990 ⁶⁰	21 (NR)	10	2	Wound infection (n=3); partial wound dehiscence (n=9)	
Sheckter et al., 2016 ⁴⁹	0 (0.0)	0	0	None	
Shepherd et al., 1990 ⁵⁵	4 (NR)	0	0	None	
Smith et al., 1998 ⁴⁷	25 (NR)	5	4	Wound infection (n=5); partial wound dehiscence (n=2); large wound dehiscence (n=2)	
Stein et al., 2019 ⁵⁹	63 (NR)	NR	NR	Wound infection (n=4); partial wound dehiscence (n=5); large wound dehiscence (n=3); necrosis (n=5)	
Tei et al., 2003 ⁶¹	16 (NR)	5	2	Large wound dehiscence (n=2); incisional herniation (n=3); sensory disorders (n=2)	
Touny et al., 2014 ³⁰	24 (NR)	NR	NR	Wound infection (n=6); incisional herniation (n=6); burst abdomen (n=3)	

* total number of complications of the reconstruction site reported and percentage of patients with one or more complications, § value for all study patients (no specific value for only VRAM-reconstruction patients available), (p) pre-surgery, (i) intra-operative
NR: not reported, VRAM: vertical rectus abdominis myocutaneous

	Complications recipient site			General complications
	Minor	Major	Specification	
	12	1	Delayed healing (n=1); wound infection (n=5); partial wound dehiscence (n=6); ongoing bleeding (n=1)	Small bowel obstruction (n=1)
	NR	NR	Wound infection (n=1); complete flap loss (n=1); hematoma (n=1); sinus formation (n=1)	Ileus (n=1)
	8	3	Superficial epidermiolysis (n=4); partial wound dehiscence (n=3); lymphocutaneous fistula (n=1); urethral/urethric damage (n=3)	Urinary tract infection (n=1); urine retention (n=1); pneumonia (n=1)
	7	2	Wound infection (n=3); partial flap loss (n=3); complete flap loss (n=1); vaginal fistula (n=1); prolaps neovagina (n=1)	Ischemic leg (n=1)
	0	0	None	Failure to thrive (n=1); delayed viscous injury (n=1)
	3	1	Partial flap loss (n=2); complete flap loss (n=1); abscess (n=1)	Deep venous thrombosis (n=1); urinary tract infection (n=3); pulmonary embolus (n=1)
	NR	NR	Partial flap loss (n=1); complete flap loss (n=1); hematoma (n=1); stenosis (n=5); vaginal fistula (n=1); urethral/urethric damage (n=7)	NR
	NR	NR	Wound infection (n=12); partial wound dehiscence (n=13); large wound dehiscence (n=4); partial flap loss (n=4); complete flap loss (n=5); seroma (n=3); hematoma (n=2); cellulitis (n=3)	Deep venous thrombosis (n=2); urinary tract infection (n=4); small bowel obstruction (n=4); ileus (n=7)
	9	0	Superficial epidermiolysis (n=6); stenosis (n=3)	Small bowel obstruction (n=1)
	NR	NR	Delayed healing (n=3); wound infection (n=3); partial wound dehiscence (n=2); abscess (n=1)	Deep venous thrombosis (n=3); shock (n=1)

CHAPTER 3

Complications after vulvar and perineal reconstruction with a lotus petal flap

Joke Hellinga

Patrick C.K.H. Khoe

Martin W. Stenekes

Yassir Eltahir

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ABSTRACT

Background

Lotus petal flaps are often used to reconstruct defects in the vulvoperineal area. Wound complications occur more often after surgery in the vulvoperineal area than in other areas of the body. Postoperative complications have a great impact on patients' well-being, length of hospital stay, care needed, and return to participation in daily life. Therefore, it is important to determine which patients are more prone to develop complications.

Methods

All lotus petal flap reconstructions in our center between January 2004 and August 2014 were retrospectively reviewed. Complications were categorized by the Clavien-Dindo classification.

Results

Ninety-three patients with 137 flaps were reviewed. The complication rates did not differ significantly between the reconstruction areas. In 30.1% of subjects, no complications were reported. A total of 51.7% of the subjects experienced Clavien-Dindo grade I or II complications, which required no or minor intervention. In 18.3% of subjects, intervention was required under general anesthesia (Clavien-Dindo grade IIIb complications), usually for debridement (64.7%). Donor site morbidity occurred in 14.0% of the subjects. The age group younger than 60 years old showed a significantly higher rate of complications compared with the group older than 60 years ($p=0.015$; odds ratio, 0.235; 95% confidence interval, 0.073-0.754).

Conclusion

This is the largest study to date on the complications of the lotus petal flap reconstruction. Complication rates did not differ between vulvar, perineal, and vulvoperineal reconstruction. Young patients seem to have a higher risk of developing complications.

INTRODUCTION

Defects in the vulvoperineal area are often reconstructed using a lotus petal flap. The vulvoperineal area is known for frequent wound complications due to the high density of bacteria in this area.^{1,2} In oncological cases, radiotherapy may also contribute to wound healing problems. Complications influence patients' well-being, length of hospital stay, care needed, and return to participation in daily life.¹⁻³ To objectively report postoperative complications, the Clavien-Dindo classification is widely used in the surgical field.⁴ The Clavien-Dindo classification may reflect the impact of the complication and intervention performed.⁴ Although this is the most widely recognized classification system in evaluating complications after surgery, it has never been applied to studies on lotus petal flap reconstruction. The reason for this may be that results after lotus petal flap reconstruction are usually reported in small studies. Argenta et al. noted that these small studies describe lower rates of flap loss and complications compared with larger series, suggesting reporting bias in smaller studies or a regression to a truer mean in the larger studies.⁵ Complications may have impact; therefore, it is important to know which factors contribute to the development of complications. Although the extent of the tumor largely decides the type of reconstruction, we were interested in finding out whether the area of reconstruction (vulvar, perineal, or vulvoperineal) mattered regarding the risks of complications.

The lotus petal flap is based on a rich arterial anastomotic network consisting of the perforators of the internal pudendal artery. This flap is named after its design resembling the petals of the lotus flower.⁶ The lotus petal flap was applied in vulvar reconstruction since 1996.⁶ There are several advantages of using a lotus petal flap over other flaps. First of all, the donor site being away from the malignant lesion and the route of tumor spread. Second, the tissue used for reconstruction is not damaged by radiotherapy, which positively influences the wound healing. In addition, the lotus petal flap has good esthetic results at the donor site and vulvar region.⁷ Furthermore, raising the flap is relatively easy and fast; however, planning and modeling of the flap requires some practice. Few compromises to the functionality of the donor site have to be made because only subcutaneous tissue is used.⁷ The versatility made it possible to recently perform perineal reconstruction with the lotus petal flap.^{1,8} The variety in size of the perineal defects makes the versatile lotus petal flap a solid reconstructive option.

In this large, retrospective study of consecutive patients, we review and compare the complications of vulvar, perineal, and vulvoperineal reconstruction and show their impact by categorizing them according to the Clavien-Dindo classification. We aim to determine which factors influence the development of complications. The study results may help us to better inform the patients before surgery.

METHODS

Surgical reports of all patients on lotus petal flap reconstruction in our center between January 2004 and August 2014 were retrospectively reviewed. All lotus petal flap reconstructions performed following vulvar, perineal, or vulvoperineal excision were included. In case multiple procedures were performed, only the first procedure was included. Secondary procedures were excluded and regarded as a complication of the first procedure.

Patient files were reviewed for patient demographics, tumor characteristics, resection details, reconstruction details, and complications of the reconstruction. The location of the defect was recorded as vulvar, perineal, or vulvoperineal. Complications were categorized by the Clavien-Dindo classification.⁴ This objective classification is based on the performed intervention for the complication. The scale is from 0 to V, in which 0 is no complication and V is death. Figure 1 shows examples of different stages of the Clavien-Dindo classification. Grades I and II are considered as minor complications and grade III and higher as major complications.

Vulvar reconstruction with the fasciocutaneous flap was performed as originally described by Yii en Niranjan.⁶ Depending on the location and size of the defect, unilateral or bilateral lotus petal flaps were marked in the gluteal or inguinal

Figure 1. Examples of Clavien-Dindo classification

Left: a 82-year-old woman after resection of anus carcinoma (supine position). The defect is reconstructed with a unilateral infragluteal fold lotus petal flap. The patient is experiencing wound dehiscence, which is treated with daily rinsing the wound (Clavien-Dindo classification grade II). **Right:** a 55-year-old woman after resection of vulvar carcinoma (lateral position). The defect is reconstructed with bilateral infragluteal fold lotus petal flaps. The patient is experiencing necrosis of the distal flaps, which is treated by necrotomy under general anesthesia (Clavien-Dindo classification grade IIIb).

fold. After tumor resection, the flap was incised until the fascia and elevated from laterally towards medially. Large medial (pudendal) perforators were spared if possible. The flap was positioned into the defect. The donor site was closed primarily. After closure of the donor site, the flap was modeled into the defect and closed in layers. Deep parts of the flap were deepithelialized if applicable. In case of the gluteal fold as donor site, we prescribed an air-fluidized bed for 1 week and prohibit sitting for 3 weeks. If necessary, pelvic floor reconstruction was combined with use of an omentoplasty or biological mesh.^{1,8}

Descriptive statistics were given for categorical data as n (%). Continuous data were tested for normality with the Shapiro-Wilk test. Normal distributed data were presented as mean (SD); other data as median (range). The IBM SPSS statistics version 20.0 was used for internal comparisons using the Kruskal-Wallis test. In case a significant difference was found in the 3 groups, the Pearson χ^2 test was performed to study the difference between 2 groups.⁹ The influence of the risk factors on the outcomes was analyzed with the logistic regression. A p-value of less than 0.05 was considered significant.

RESULTS

All 93 patients that underwent reconstruction with a lotus petal flap were included in this study. Two subjects underwent multiple procedures, and therefore, the second procedure was excluded. A total of 137 lotus petal flaps were performed. Forty-five of the 93 subjects (48.4%) underwent a vulvar reconstruction; 34 subjects (36.6%), a perineal reconstruction; and 14 subjects (15.1%), a combined vulvar and perineal reconstruction. The median time of follow-up was 26.3 months (5.5-119.7). Patient characteristics of groups can be found in Table 1. As expected, sex was significantly different between the vulvar and perineal reconstruction group (100% female respectively (resp.) 70.6% female; $p=0.002$). Sex was also significantly different between the perineal and combined reconstruction group (70.6% female resp. 100% female; $p=0.021$). The timing of radiotherapy, either neoadjuvant or adjuvant, was significantly different in the vulvar reconstruction group compared with the perineal reconstruction group ($p=0.001$). Unsurprisingly, the air-fluidized therapy bed was significantly less commonly used in the vulvar group compared with the perineal group ($p<0.001$) and the combined group ($p=0.006$).

The complications were grouped according to the Clavien-Dindo classification (Table 2). A total of 30.1% of the subjects did not have any complication. Minor complications (grade I and II) occurred in 51.7% of the subjects and major complications (grade III and higher) in 18.3%. The main reason for intervention under general anesthesia (grade IIIB) was wound debridement (64.7%). Other

Table 1. Patient characteristics

	Total (n=93)	Vulvar (n=45)	Perineal (n=34)	Combined (n=14)	Difference between groups (p-value)
Female sex – n (%)	83 (89.2)	45 (100)	24 (70.6)	14 (100)	<0.001*
Age – median (range) in years	68.2 (18.9–91.9)	71.9 (18.9–91.9)	63.4 (27.8–82.5)	57.9 (37.6–81.7)	0.072
Body Mass Index – median (range) in kg/m ² (n=86)	27.0 (17.8–45.0)	27.3 (20.3–45.0)	26.6 (18.1–39.9)	26.7 (17.8–41.7)	0.318
Smoking behavior – n (%)	21 (22.6)	7 (15.6)	9 (26.5)	5 (35.7)	0.677
Active smoker	7 (7.5)	7 (15.6)	0 (0.0)	0 (0.0)	
Former smoker	65 (69.9)	31 (68.9)	25 (73.5)	9 (64.3)	
Never					
Radiotherapy – n (%)					0.009*
Neoadjuvant	55 (59.1)	17 (37.8)	27 (79.4)	11 (78.6)	
Adjuvant	11 (11.8)	10 (22.2)	0 (0.0)	1 (7.1)	
Neoadjuvant and adjuvant	3 (3.2)	2 (4.4)	1 (2.9)	0 (0.0)	
Never	24 (25.8)	16 (35.6)	6 (17.6)	2 (14.3)	
Indication – n (%)					0.123
Oncology	80 (86.0)	40 (88.9)	26 (76.5)	14 (100)	
Fistula	7 (7.5)	0 (0.0)	7 (20.6)	0 (0.0)	
Lichen sclerosis	4 (4.3)	4 (8.9)	0 (0.0)	0 (0.0)	
Herniation	1 (1.1)	0 (0.0)	1 (2.9)	0 (0.0)	
Morbus Zoon	1 (1.1)	1 (2.2)	0 (0.0)	0 (0.0)	
Bilateral use – n (%)	44 (47.3)	22 (48.9)	14 (41.2)	8 (57.1)	0.580
Donor site – n (%)					0.749
Gluteal fold	69 (74.2)	30 (66.7)	28 (82.4)	11 (78.6)	
Groin	22 (23.7)	13 (28.9)	6 (17.6)	3 (21.4)	
Upper leg	2 (2.2)	2 (4.4)	0 (0.0)	0 (0.0)	
Use of air-fluidized bed – n (%)	49 (52.7)	11 (24.4)	29 (85.3)	9 (64.3)	<0.001*

* in case of a significant difference tested by the Kruskal-Wallis test, the difference between each group was tested using the Pearson 2 test. Significant differences between groups are mentioned in the “Results” section.

reasons were (partial) flap loss, which required reconstruction with a second flap (29.4%), and abscess drainage (5.9%). Donor site morbidity, mostly dehiscence, was seen in 14.0% of the cases and was not significantly different between the reconstruction sites ($p=0.528$). Complications of grade IV or V were not reported. The incidence of all complications and major complications alone were not significantly different between the different reconstruction groups ($p=0.509$ resp. $p=0.105$).

Table 2. Complications of the lotus petal flap procedure categorized by the Clavien-Dindo classification

Grade	Total (n=93) n (%)	Vulvar (n=45) n (%)	Perineal (n=34) n (%)	Combined (n=14) n (%)
0	28 (30.1)	16 (35.6)	9 (26.5)	3 (21.4)
I	42 (45.2)	21 (46.7)	15 (44.1)	6 (42.9)
II	6 (6.5)	3 (6.7)	3 (8.8)	0 (0.0)
IIIa	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
IIIb	17 (18.3)	5 (11.1)	7 (20.6)	5 (35.7)
IV	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
V	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

From the regression model, we found that a younger age was associated with a significantly higher risk of complications compared with a higher age ($p=0.037$). The cutoff point is around the age of 60 years. We compared the group younger than 60 years with the older group. The younger group showed a significantly higher rate of complications compared with the older group ($p=0.015$; odds ratio 0.235; 95% confidence interval 0.073-0.754). To further explore this surprising result, we tested if there were significant differences between the 2 age groups (younger than 60 years compared with older than 60 years). However, we found no differences in sex, smoking habits, body mass index, tumor type, T(NM) classification, resection type, donor site, radiotherapy, and chemotherapy. All other factors (e.g. bilateral use of lotus petal flaps) did not show a significant influence on the development of complications and did not significantly contribute to the risk of reoperation (major complication, grade III and above). The patients who did not develop a complication were excluded for this regression to be sure that only the risk of reoperation, instead of complication in general, was measured.

DISCUSSION

To our knowledge, this study is the largest to date on lotus petal flap reconstruction on consecutive patients including vulvar, perineal, and vulvoperineal reconstructions. We found no significant differences in complication rates between the locations of the reconstruction areas. This study is also the only one reporting the complications after lotus petal flap reconstruction using an objective standardized classification system. A younger age significantly influenced the development of complications.

Complications, especially wound healing issues, often occur in the vulvoperineal area, which has a high bacterial count.¹⁰ It is known that complications greatly impact a patient's well-being and recovery after the reconstruction.¹⁻³ Therefore, we were interested in finding factors that influence the development of complications. This will help us to improve the information patients receive before surgery.

Radiotherapy in the perineal group was always neoadjuvant, whereas in the vulvar group, adjuvant radiotherapy was also applied. This difference is based on the difference in standardized treatment protocols. The use of an air-fluidized therapy bed was less common in the vulvar reconstruction group. This can be explained by less pressure on the wounds when in supine position. Use of air-fluidized therapy beds was added to our postoperative protocols during the study period because we felt the bed aided in preventing wound healing problems.

Complications were reported according to the Clavien-Dindo classification to objectively review the complications and facilitate comparison with other studies in the future. The classification is based on the intervention required to treat the complication, which means based on the impact the complication has on the patient and his or her return to participation in daily life.⁴ Our minor complication rates seem higher compared with previous reports. In most other reports, complications were usually only reported when intervention was performed. Minor complications were not always mentioned. We intended to register all complications. Barker et al. reported that grade I complications are often being reported as insignificant; however, they showed that grade I complications after vertical rectus abdominis reconstruction led to prolonged hospital admission by an average of 4 days.³

In addition, because of the larger study population, we assume that our study could show a regression to a truer mean.⁵ This option is also supported by a recent study of Argenta et al., which also showed higher complications rates in comparison to smaller studies as well.⁵ Our complication rates seem comparable with other currently used techniques like the vertical rectus abdominis reconstruction, which showed a complication rate of 65%.¹¹ Distinctions between complications of the defect site or donor site were not reported in previous studies.

Regression analyses showed that younger patients, especially those younger than 60 years, are more prone to develop complications. We found no other significant differences between the age group younger than 60 years compared with older than 60 years. We think that this difference may be caused by the fact that the mean age of patients with perineal tumors is younger than the mean age of patients with vulvar tumors, and therefore, this finding does not influence clinical decision-making. The complication rate, especially major complications, is larger in the perineal group. However, this difference was not significant in our series, which could be caused by a relatively small series and heterogeneity, which is inevitable for this type of reconstruction in a single-center study. Possibly, the

younger patients are more eager to start mobilization in a too-early stage for adequate wound healing.

The best available outcome variables were analyzed in this study. However, because of the retrospective nature of this study, some desired variables were unavailable. For example, the exact size of the defects was usually not recorded in patient files. The requirement of a unilateral or bilateral lotus petal flap may be indicative for the size of the defect, but we found no difference in complication rates. For clarity, we decided to report the complications per patient instead of per flap. This way, patient factors are only weighed once, and complications were more reliably documented.

The strengths of this study include the large sample size of consecutive cases over 10 years. The majority of the reconstructions have been performed by 2 plastic surgeons. Furthermore, it uses an objective classification system to categorize the complications after the reconstruction, preventing minor complications from staying unreported and showing the impact of the complications.

The weaknesses of this study are inherent to its retrospective study design. This design may create inconsistency of reporting data, lacks standardized follow-up, and carries the risk of selection bias. Unfortunately, performing a prospective study of this size is not feasible in our institution because of the small number of reconstructions performed per year. We tried to reduce the risk of selection bias by including consecutive cases. In addition, heterogeneity is inevitable because of resection of all different tumor types performed before lotus petal flap reconstruction. This could be prevented by only including 1 tumor type followed by 1 type of resection. However, because of the small number of reconstructions each year, this is not feasible. The retrospective design is not feasible to study the quality of life and patient satisfaction. Currently, we are designing a new study to be able to report this in the near future.

Conclusion

This large, retrospective study demonstrates that lotus petal flap reconstruction has comparable results in reconstruction of vulvar, perineal, and vulvoperineal defects. Most documented complications are categorized as minor complications. Younger patients seem to be more prone to develop complications.

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CHAPTER 4

Quality of life and sexual functioning after vulvar reconstruction with the lotus petal flap

Joke Hellinga*

Nienke C. te Grootenhuys*

Paul M.N. Werker

Geertruida H. de Bock

Ate G.J. van der Zee

Maaïke H.M. Oonk

Martin W. Stenekes

* these authors contributed equally

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ABSTRACT

Background

Resection of (pre)malignant lesions in the vulvoperineal area may result in large defects that cannot be closed primarily. The lotus petal flap technique is widely used for reconstruction. The aim of this study was to evaluate both quality of life (QoL) and sexual functioning of patients who underwent the lotus petal flap procedure, because no data are available on this topic.

Methods

A cross-sectional study was performed on all eligible patients (n=38) who underwent the lotus petal flap procedure between 2005 and 2016. The European Organization for Research and Treatment of Cancer Quality of Life Questionnaire C30, Female Sexual Function Index, and Body Image Scale were used to evaluate QoL and sexual functioning. The European Organization for Research and Treatment of Cancer Quality of Life Questionnaire C30 and Female Sexual Function Index scores were compared with scores of age-matched healthy women.

Results

Twenty-six patients (68%) responded. The mean (SD) age was 65.5 (16.3) years, and median follow-up time was 38.5 months (range 16-141 months). Quality of life scores were lower compared with healthy women in the domains physical, role, and social functioning. Sexual activity rates were comparable with healthy women; however, sexual functioning was worse. Although patients were satisfied about their sexual life, pain was reported.

Conclusion

Patients who underwent vulvar reconstructive surgery with lotus petal flaps seem to have a lower QoL compared with healthy women. Patients report more pain during sexual activity but are satisfied about their sexual functioning. These results should be included in preoperative counseling and follow-up of future patients eligible for vulvar reconstruction with a lotus petal flap.

INTRODUCTION

Treatment of vulvar and rectal (pre)malignant disease sometimes includes extensive excision of these tumors, resulting in large defects that cannot be closed primarily. The resulting wound may be reconstructed using a local or regional flap. In vulvar cancer, little is known about the impact of surgical treatment and vulvar reconstruction on quality of life (QoL) and sexual functioning. Aerts et al. reviewed the literature on the impact of vulvectomy in 456 patients and stated that there is an urgent need for studies investigating these factors, with special attention for psychosocial factors (e.g. body image), applying validated questionnaires.¹ However, none of these patients underwent the lotus petal flap procedure.

As part of primary treatment, some patients (with both vulvar and rectal carcinoma) receive (neo)adjuvant therapy, which may cause inflammation in the acute phase. In a later phase, (vaginal) fibrosis and edema frequently cause sexual dysfunction due to narrowing of the vaginal introitus, reduced sensation, and loss of elasticity.^{2,3} Especially in case of treatment for recurrent disease and/or previous radiotherapy, reconstruction with healthy nonirradiated tissue is often required. However, good results after reconstructive surgery are challenged by the fact that, by definition, the perineal and vulvar area are contaminated. This may delay wound healing. Furthermore, wound dehiscence may occur owing to poor perfusion of the remaining wound edges or tension on the wound borders.

In the past, skin grafts were used to cover large defects. It carries the risk of (partial) loss of the skin graft, contracture, and vaginal stenosis.^{4,5} Several flap transposition techniques for reconstruction have been reported, but little is known about their postoperative outcome and their impact on the QoL and sexual functioning.⁶ In our center, the fasciocutaneous lotus petal flap procedure has been used since 2005 for vulvar and perineal reconstruction.⁷ The lotus petal flap, first described by Yii and Niranjani, uses local tissue from an area where scars can be easily hidden in the fold of the buttocks or groins.⁸ The lotus petal flap technique is useful in numerous situations. The vulvoperineal area has a rich blood supply, making it an ideal donor site for flaps. In addition, application of a lotus petal flap does not impair the form and function of the donor site such as for instance the vertical rectus abdominis musculocutaneous flap does.^{9,10}

To our knowledge, no information is available on the sexual functioning and QoL of patients after a vulvar reconstruction using lotus petal flaps. We hypothesize that sexual functioning and QoL will be lower compared with healthy subjects. However, the extent of the problems is unknown. Therefore, in this study, the aim is to evaluate sexual functioning and QoL of patients who underwent a reconstruction with a lotus petal flap as part of surgery for vulvar or rectal disease.

METHODS

Patients

This cross-sectional study included all patients who underwent vulvar reconstruction with the lotus petal flap procedure at the University Medical Center Groningen (UMCG) between January 2005 and January 2016. Patients were excluded when they were unable to fill out the questionnaires owing to inadequate understanding of the Dutch language or in case of cognitive impairment or dementia. The medical ethical committee of the UMCG decided that formal approval for this study was unnecessary. All patients gave written informed consent.

Data collection and questionnaires

Data were collected using patient files and questionnaires. Quality of life was evaluated with the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire C30 (EORTC QLQ-C30), which is developed to study general QoL in cancer patients. Quality of life scores were divided into three domains: 1) global health status, 2) functional scales, and 3) symptom scales. High scores in the first two scales correlated with respectively a high level of functioning and high QoL scores. A high score in the symptom scale correlated with a high level of complaints.¹¹ Cronbach α coefficients for the EORTC QLQ-C30 domains were 0.86 for global health status, 0.68 for physical functioning, 0.54 for role functioning, 0.73 for emotional functioning, 0.56 for cognitive functioning, 0.68 for social functioning, 0.80 for fatigue, 0.82 for pain, and 0.65 for nausea and vomiting.¹²

Sexual functioning and body image were scored by using the Female Sexual Function Index (FSFI) and the Body Image Scale (BIS).¹³⁻¹⁶ The FSFI focuses on sexual desire, sexual worries, and satisfaction with sexuality. The domains for sexual function are as follows: desire, arousal, lubrication, orgasm, satisfaction, and pain. A high score indicated a higher level of satisfaction with the sexual functioning.^{13,14} For the FSFI domains, the Cronbach α coefficients were 0.92 for desire, 0.95 for arousal, 0.96 for lubrication, 0.94 for orgasm, 0.89 for satisfaction, 0.94 for pain, and 0.97 for the total score.^{13,14} The BIS is a cancer-specific measure to assess satisfaction with body image and appearance. A low BIS score indicates less concern with body image.^{15,16} For the BIS questionnaire, the Cronbach α coefficient was 0.93.¹⁵ All three questionnaires are validated for Dutch language. Furthermore, patients scored their satisfaction regarding functional and esthetic outcome on a 10-point Likert scale. A high score indicates a higher level of satisfaction.

Missing items in all questionnaires were handled as recommended in the EORTC scoring manual.¹¹ Questionnaire domain scores were considered missing in case less than half of the items within a domain were missing. When at least half of the items were available, missing scores were calculated as a mean of the available items within the domain. The Cronbach α coefficients for each questionnaire of the study group are reported in the supplementary data (Table S1).

Table S1. Cronbach's alpha of EORTC QLQ-C30, FSFI and BIS questionnaires for study group

Questionnaire	Domain	Cronbach's alpha
EORTC QLQ-C30	Global health status	0.92
	Functioning scales	
	Physical functioning	0.74
	Role functioning	0.74
	Emotional functioning	0.91
	Cognitive functioning	0.68
	Social functioning	0.87
	Symptom scales	
	Fatigue	0.86
	Pain	0.90
	Nausea and vomiting	n/a
FSFI	Desire	0.73
	Arousal	0.93
	Lubrication	0.95
	Orgasm	0.74
	Satisfaction	0.78
	Pain	0.97
	Total score	0.96
BIS	Total score	0.91

BIS: Body Image Scale, EORTC QLQ-C30: European Organization for Research and Treatment of Cancer Quality of Life Questionnaire-C30, FSFI: Female Sexual Function Index, n/a: not available: could not be determined due to only 0.0 scores

Data analysis

Follow-up time was calculated in months from date of surgical reconstruction until the date of filling out the questionnaire. For comparison, the results of the EORTC QLQ-C30, FSFI, and BIS questionnaires were stated as mean (standard deviation [SD]), because most studies on this subject used the mean for description of EORTC QLQ-C30 and BIS. The scores of the EORTC QLQ-C30 were compared to the Swedish reference data of women aged 60 to 69 years in the general population.¹⁷ The FSFI values were compared with data from the general Dutch population of women aged 60 to 70 years.¹⁸ Comparison of the EORTC QLQ-C30 and FSFI values with the reference data was performed by plotting all values of our study group and the mean values and the 95% confidence intervals of both our study group and the reference data in one graph. No statistic tests were performed for both questionnaires owing to the small study population. To test correlation between age and results of the questionnaires and between follow-up time and results of the questionnaires, the Spearman rank order correlation coefficient (ρ) was calculated. A p-value <0.05 was considered significant. Statistical analyses were performed with IBM Statistical Package for the Social Sciences (SPSS) version 23 (IBM Corp., Armonk, NY).

RESULTS

Patient characteristics

Between January 2005 and January 2016, 71 patients underwent vulvar reconstruction with the lotus petal flap procedure at the UMCG. Thirty-three of these patients died before the start of this study. Questionnaires were sent out to the remaining 38 patients of whom 26 (68%) responded. Four patients were unable to fill out the questionnaires owing to cognitive impairment or dementia. Twenty-two patients (58%) returned the written consent and the questionnaires (Figure 1). Indications for resection varied in our study population: vulvar cancer or dysplasia and anal or rectal cancer. Differences between these groups were tested for all questionnaires. Except for diarrhea and emotional functioning in the EORTC QLQ-C30, no differences were found. Because of this and the fact that the operated areas are overlapping, data are presented for the entire study group. The median time between reconstruction and evaluation by questionnaire was 38.5 months (range 15.8-141.4 months). The mean (SD) age at evaluation was 65.5 (16.3) years. Patient, tumor, resection, and reconstruction characteristics are depicted in Table 1.

Figure 1. Flow chart of the study population

Table 1. Patient, tumor, resection, and reconstruction characteristics

	n [%]
Age (years)	65.5 (16.3)*
Body Mass Index (kg/m ²)	24.4 (18.1 – 40.4)*
ASA	
- class I	5 (22.7)
- class II	17 (77.3)
Smoking	
- no	16 (72.7)
- past	3 (13.6)
- current	3 (13.6)
Comorbidity	
- hypertension	18 (81.8)
- thyroid disease	2 (9.1)
- diabetes mellitus	1 (4.5)
- hypertension and diabetes mellitus	1 (4.5)
Disease type	
- vulvar carcinoma	12 (54.5)
- rectum carcinoma	4 (18.2)
- anal carcinoma	2 (9.1)
- lichen sclerosus	2 (9.1)
- Ewing sarcoma	1 (4.5)
- morbus Zoon	1 (4.5)
Resection type	
- partial vulvectomy	11 (50.0)
- total vulvectomy	3 (13.6)
- APE + posterior exenteration	3 (13.6)
- APE	2 (9.1)
- APE + total exenteration	2 (9.1)
- APE + distal sacrum resection	1 (4.5)
Radiotherapy	
- none	9 (40.9)
- neoadjuvant	12 (54.5)
- adjuvant	1 (4.5)
Chemotherapy	
- none	17 (77.3)
- neoadjuvant	3 (13.6)
- adjuvant	1 (4.5)
- neoadjuvant + adjuvant	1 (4.5)
Donor site location	
- groin	11 (50.0)
- infragluteal fold	11 (50.0)
Number of donor sites	
- one sided	10 (45.5)
- two sided	12 (54.5)
Complications donor site [‡]	
- none	16 (72.7)
- Clavien-Dindo class I	5 (22.7)
- Clavien-Dindo class II	1 (4.5)
- Clavien-Dindo class III and higher	0 [0]
Complications acceptor site [‡]	
- none	9 (40.9)
- Clavien-Dindo class I	8 (36.4)
- Clavien-Dindo class II	1 (4.5)
- Clavien-Dindo class III and higher	4 (18.2)
Multiple resections	6 (27.3)

* in mean (standard deviation)

in median (range)

‡ Clavien-Dindo classification: class I, complication without intervention; class II, complication requiring pharmacological treatment; class III and higher, intervention requiring surgical treatment¹⁹

APE: abdominoperineal excision, ASA: American Society of Anesthesiologists

Footnote: One of the patients in the vulvar group showed complications unrelated to the recipient or donor site. She became septic based on an intestinal necrosis due through herniation of the small intestines around her colostomy. The ischemic part of the colon was resected. Second, she developed pneumonia with acute respiratory distress syndrome and lung embolism. She fully recovered after a 26-day stay on the intensive care unit.

Quality of Life

The scores on the different domains and the reference values of healthy women are presented in Figure 2. Our study population showed a decrease on the physical functioning, role functioning, and social functioning scales. The global health status, emotional functioning, and cognitive functioning were comparable. On the symptom scales, the study group reported more fatigue, insomnia, diarrhea, and financial difficulties, but less dyspnea. Complaints of nausea and vomiting, pain, and appetite loss were comparable between our study group and the reference values. The EORTC QLQ-C30 score diarrhea was significantly correlated with age ($\rho=-0.44$, $p=0.04$), showing more complaints of diarrhea in younger patients.

Figure 2. EORTC QLQ-C30 scores of study group and references
Quality of life scores of all 22 patients in the study group and both mean and 95% confidence intervals are plotted for study group (blue) and reference group (red); women aged 60 to 69 years from Michelson et al.¹⁷ (2000). A high score in the functioning scales (top) correlates with a high level of functioning and QoL. A high score in the symptom scales (bottom) correlates with a high level of complaints.

Footnote: One score of study group is missing in the complaint scale financial difficulties.

Sexual functioning

Nineteen of the 22 patients filled out the FSFI questionnaire of which ten patients (53%) reported to be sexually active. Figure 3 shows the FSFI scores for the different domains and the total scores for all 10 sexually active patients in the study group and reference data. Two patients (20.0%) scored above the normal sexual functioning border of 26.0.²⁰ Four patients (40%) reported vaginal penetration in the past 4 weeks. Interestingly, the domain satisfaction showed the highest score of all domains. This score and the desire scores were comparable with the Dutch general population (Figure 3).¹⁸ All other domains were scored lower in our study group. Within the group of sexually active patients, there was a significant negative correlation between age and the total FSFI score ($\rho=-0.75$, $p=0.02$) and between age and the FSFI domain orgasm ($\rho=-0.71$, $p=0.02$), meaning that older patients had lower scores and therefore worse sexual function.

Body image

All 22 patients completed the BIS questionnaire. The mean (SD) total score of the BIS questionnaire was 9.6 (7.3) out of a maximum of 30.0 (Figure 4). The BIS score was negatively correlated with age ($\rho=-0.48$, $p=0.02$), meaning that older patients had lower scores and less concern with body image.

Figure 3. FSFI scores of study group and references

The FSFI scores for all 10 sexually active patients of the study group and both mean and 95% confidence interval are plotted for the study group (blue) and the reference group (red); women aged 60 to 70 years from Lammerink et al.¹⁸ [2017].

A high score indicates a higher level of satisfaction with the sexual functioning.

Footnote: The total score of 1 patient could not be reported because the score of the domain lubrication was missing.

Figure 4. BIS total score of study group
A low BIS score indicates less concern with body image.

Figure 5. Satisfaction scores of study group
A high score indicates a higher level of satisfaction.

Functional and esthetic satisfaction outcome

All 22 patients completed the two questions regarding satisfaction with functional and esthetic outcome. Satisfaction was scored on a Likert scale from 0 to 10, in which a score of 10 correlates with the highest possible satisfaction. The median score on functional outcome was 7 (interquartile range 6-8), and on esthetic outcome was 7 (interquartile range 5-8) (Figure 5). Satisfaction scores were not significantly correlated with age or follow-up time.

DISCUSSION

In this study, the QoL, sexual functioning, and body image of patients who underwent a vulvar reconstruction using the lotus petal flap technique was evaluated. Quality of life scores seemed overall lower compared with healthy females. In particular, the functioning scales and sexual functioning were lower compared with healthy women.

Quality of life

Compared with healthy females aged 60 to 69 years, our study group scored significantly worse on physical functioning, role functioning, and social functioning. All other functioning and symptom scores were comparable. Data on QoL after vulvar surgery are scarce.^{1,21-23} Oonk et al. compared the QoL of a group that underwent sentinel lymph node procedure only with a group that underwent inguinofemoral lymphadenectomy, both after wide local excision for vulvar cancer.²² The wounds of these patients were closed primarily (without reconstruction with a soft tissue flap). In the present study, EORTC QLQ-C30 scores were worse except for the symptom scales nausea and vomiting, dyspnea, and appetite loss. It is likely that the differences in QoL between that study and our study may be explained by the fact that the excision defects were larger in our study, because the defects could not be closed primarily. Novackova et al. studied the QoL of patients who underwent vulvar cancer surgery and inguinofemoral lymphadenectomy 12 months after surgery.²³ Their global health status scores were lower compared with the ones in our study group (64.91 vs 75.76), but their functional scales were comparable or higher. On the symptom scales, only the fatigue, pain, and financial difficulties scored clearly worse by our study group; all other scales scores were better. Likes et al. also studied QoL after vulvar excision using the EORTC QLQ-C30.²⁴ They reported a decrease of QoL with increasing age. It was impossible to compare this with our study group because the subscores were unavailable.

Sexual functioning

More than half of the patients (53%) of our study group were sexually active after vulvar reconstruction with the lotus petal flap technique. This is comparable with the reported rate of 48% sexually active woman aged 60 to 70 years by Lammerink et al.¹⁸ Only 40% of those patients also had vaginal penetration in the past four weeks. In Table 2, we present relevant studies that used the FSFI questionnaire in vulvar cancer patients and healthy women. For comparison reasons, we noted both the mean and median score of our study group in Table 2. The sexual activity rate in our study group is relatively high compared with any other study performed in vulvar cancer patients using the FSFI questionnaire.^{21,24-26} In a large study of Lindau et al. on healthy adults from the United States, 39.5% of the female age group 65 to 74 years reported to be sexually active.²⁷ This is also lower compared with our study group with a comparable mean age.²⁷ However, in the two studies

Table 2. Overview of studies involving vulvar cancer patients or healthy women using the FSFI questionnaire

	Patient group	No. patients	Mean age (years)	Sexually active (%)	FSFI total score (median / mean)	FSFI domains - Desire, - Arousal, - Lubrication, - Orgasm, - Satisfaction, - Pain (median / mean)
Study group	Vulvar disease n=7 and Rectal/anal disease n=3 treated with excision and vulvar reconstruction using lotus petal flap	10	65.5	45.5 (10/22)	14.9	2.7 2.4 3.0 3.0 4.6 0.0
De Melo Ferreira et al., 2012 ²⁵	Vulvar cancer treated with vulvectomy and inguinofemoral lymphadenectomy	28	66.9	21.4	18.8	2.4 2.4 3.6 1.8 3.2 5.0
	Age-matched control group of healthy women	28	66.9	32.1	21.4	2.4 3.6 3.0 2.8 4.8 3.2
Hazewinkel et al., 2012 ²⁶	Vulvar cancer survivors; less extensive treatment: local excision (and sentinel node)	46 (N varies per domain from 13–46)	68	NR	NR	2.0 2.9 3.8 4.2 3.6 4.8

* median age, # age group 60 to 70 years
ESFI: Female Sexual Function Index, NR: not reported, VIN: Vulvar Intraepithelial Neoplasia

that reported total FSFI scores in vulvar cancer patients, these scores were higher than in our study group.^{21,25} Also, the total FSFI scores and all subdomains of our study group were worse than those of healthy Dutch women reported by Ter Kuile et al. (mean 17.1 vs 31.2).¹⁴ However, the women reported by Ter Kuile et al. are younger than in our study group (mean age 65.5 vs 27.1 years).¹⁴ Our study ($\rho=-0.75$, $p=0.02$) and several other studies showed that age is negatively related with sexual functioning.²⁴⁻²⁶ Furthermore, it has been shown that only 20% of the preoperatively sexually active women resumed intercourse after radical vulvectomy and primary closure in a group of patients aged 65 years and older.²⁸⁻³⁰ For these reasons, it is relevant to compare our data with elder healthy women. As mentioned previously, the number of sexually active women in this study is comparable with the general Dutch population.¹⁸ All sexual functioning scores are lower in our study group. Although the domains desire and satisfaction are almost comparable, when looking at the FSFI subdomains, our study group scores lowest on the domain pain (0.0), meaning that patients experience pain. The domain satisfaction scored highest within our study group (4.6). This domain scored higher compared with vulvar cancer patients with primary closure; however, it was still lower compared with healthy women from Ter Kuile et al. and the control group from De Melo Ferreira et al.^{14,25} Also, a high satisfaction on the 10-point Likert scales on esthetic and functional satisfaction was seen. Of the other subdomains, the desire scores of our study group were higher than those in the other studies involving vulvar cancer patients.^{25,26}

Regarding sexual function, Sadovsky et al. advises to inform patients and their partners preoperatively on possible changes in sexual function and to manage postoperative sexual dysfunction like those in patients without cancer.³¹ Postoperatively, the focus of clinicians should be on reviewing and managing (psycho) sexual adverse effects. As shown, patients do have sex after vulvar reconstruction and are satisfied about their sexual functioning but experience pain doing this. Pain seems to be an important issue in this patient group, and therefore, consultation of a sexologist during follow-up, and when needed a pelvic floor physiotherapist, should be considered.

Body image

Because of the lack of data on body image after vulvar surgery, Barlow et al. interviewed 10 women after treatment for early-stage vulvar cancer.³² They found that many women maintain their body image; however, woman with the most radical and multiple procedures showed a lower satisfaction with body image. Hazewinkel et al. scored the body image using the BIS questionnaire after local excision.²⁶ Their score was lower compared with the scores of our study group (5 vs 9.6), which means that their group had less concern with their body image. We found that older patients have less concern with body image. The mean age of Hazewinkel et al.'s study group was just slightly older compared to our study group (68 vs 65.5 years).²⁶

Strengths and limitations

This study is the first to show data on QoL and sexual functioning of patients undergoing a vulvar reconstruction using the lotus petal flap technique. In this study, validated questionnaires were used. The response rate in this questionnaire study was 68%, and the follow-up time was long with a median of 38.5 months. Because it is the first study to present data on sexual function and QoL for patients undergoing a lotus petal flap technique, we feel that this study has a high value for both clinicians and patients. However, this study does have some limitations. First, patients were evaluated at one single point in time and no preoperative questionnaire data were available for this analysis. Therefore, no comment on how parameters changed over time can be made. Also, the number of included patients is limited, owing to the scarcity of patients who underwent this procedure. However, this patient cohort is the largest ever presented on this subject. Furthermore, some patients underwent several surgeries in the vulvoperineal area because of recurrent disease. This might have led to a recall bias because it might be hard to determine which of the surgeries has led to a certain symptom or problem.

Conclusion

In this study the QoL, sexual function, body image, and satisfaction of patients who underwent a vulvar reconstruction using the lotus petal flap technique was evaluated. General QoL of these patients is relatively good compared with healthy females; however, their physical, role, and social functioning are significantly lower. Sexually activity rates after vulvar reconstruction are comparable with the general Dutch population. Sexual functioning is impaired compared with healthy women. Patients reported more pain during sexual activity but are satisfied about their sexual functioning. The desire scores are comparable with healthy women. Patients are satisfied with their body image, and the esthetic and functional result of the reconstruction. These data will assist in the preoperative counseling for patients undergoing vulvar reconstruction because of surgery for (pre)malignant disease. During follow-up, attention for sexual functioning and QoL is important. We recommend, based on our clinical experience, that low-threshold consultation of a sexologist or pelvic floor physiotherapist should be offered.

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PART II

Perineal reconstruction using the lotus petal flap

CHAPTER 5

Fasciocutaneous lotus petal flap for perineal wound reconstruction after extralevator abdominoperineal excision: application for reconstruction of the pelvic floor and creation of a neovagina

Joke Hellinga*

Patrick C.K.H. Khoe*

Boudewijn van Etten

Patrick H.J. Hemmer

Klaas Havenga

Martin W. Stenekes

Yassir Eltahir

* these authors contributed equally

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ABSTRACT

Background

The extralevator abdominoperineal excision (ELAPE) procedure creates an extensive soft tissue defect of the pelvic floor. It has been suggested that primary reconstruction reduces the risk of wound infection and delayed wound healing in this high-risk area. Use of myocutaneous flaps or omentoplasty are associated with functional limitations and complications. We performed the perineal variant of the lotus petal flap, which was originally described for vulvar reconstruction. We aimed to verify if application of the lotus petal flap in pelvic floor reconstruction after ELAPE meets the goals of an ideal reconstruction.

Methods

We performed a retrospective study of 28 patients who underwent the lotus petal flap procedure for pelvic floor reconstruction after ELAPE between January 2011 and March 2014.

Results

Median age was 62.1 years and 78.6% of patients were female. In most patients the tumor was preoperatively irradiated (89.3%) and in 28.6% of the reconstructions a biological mesh was applied. No total flap loss occurred. Six (21.4%) patients had no complications, while thirteen (46.4%) patients had minor complications (Clavien-Dindo grade I-II). Reoperation (Clavien-Dindo grade IIIb) was performed in nine patients (32.1%), three of whom required a second lotus petal flap reconstruction. Median time until wound healing was 14 weeks. No additional surgery was performed for aesthetic problems.

Conclusion

Reconstruction of the pelvic floor after ELAPE using the fasciocutaneous lotus petal flap has limited major complications, but still with a high incidence of minor wound complications. This retrospective cohort shows limited consequences on form and function.

INTRODUCTION

Abdominoperineal excision (APE) is treatment of choice for distal rectal carcinoma and anal carcinoma where the anus, rectum and part of the sigmoid colon are resected, as first described by Miles in 1908.¹⁻⁴ The size and location of the tumor determine whether an intersphincteric APE, a resection including the anal sphincter (regular APE), or an extralevator APE (ELAPE) is conducted.⁵ In case of an ELAPE the levator muscle is excised completely and the defect cannot be closed primarily in contrast to regular APE. In addition, an en bloc resection including the posterior vagina wall or distal part of the sacrum might be indicated in locally (very) advanced (mostly) rectal cancers.⁴

The issue in reconstruction after ELAPE is not merely the skin defect but, more importantly, the extensive soft tissue defect. This is a three-dimensional and mostly soft tissue defect of which the size depends on the extensiveness of the resection. In anal cancer patients the ELAPE is often performed with an extended perineal skin excision, compared with ELAPE for rectal cancer. Particularly in the pelvic area, it is important to reconstruct this defect.⁶ Perineal wound healing after ELAPE is delayed in up to 40% of cases due to neoadjuvant radiotherapy and the high density of bacteria of the perineal region.¹ Accumulation of fluid in the pelvic cavity increases the risk of abscess collection and seroma formation.^{1,3,4,7} Primary closure of the perineal wound combined with omentoplasty used to be treatment of choice in our center; however, we experienced abdominal hernias and extensive wound healing problems. Therefore, we have started to use a biological mesh combined with a flap to fill the dead space between the biological mesh and the perineal skin, and provide healthy, not radiated, tissue.

Primary reconstruction with well-vascularized tissue reduces the incidence of wound infections and problems with wound healing in the perineal area.⁸ At this moment, there is no consensus on the ideal reconstruction technique to fill the soft tissue defect after ELAPE.⁹ In some patients we performed the vertical rectus abdominis muscle (VRAM) flap procedure; however, we were dissatisfied with the donor site morbidity and the donor site not being accessible in prone position. Therefore, our experience in vulvar reconstruction was the basis for the application of the lotus petal flap in perineal reconstruction. The fasciocutaneous lotus petal flap, contrary to currently used techniques, may meet the criteria of an ideal reconstruction. The three principles for an ideal reconstruction technique are safety, form, and function.¹⁰

In this study, we retrospectively studied whether or not the application of the fasciocutaneous lotus petal flap in pelvic floor reconstruction after ELAPE complies with the three factors for an ideal reconstruction.

METHODS

Study design

We conducted a retrospective study of all patients who underwent the lotus petal flap procedure for pelvic floor reconstruction after ELAPE in our institution from January 2011 to March 2014. In addition, patients who underwent the lotus petal flap procedure for closure of a soft tissue defect after wide perineal excision or for reconstruction by healthy tissue after chronic wounds after ELAPE were included. Patients who were twice reconstructed with a lotus petal flap, caused by a complication of the first procedure, were only included the first time.

Surgical technique

Preoperatively, the length and width of the flap is marked in the gluteal or inguinal fold, depending on the location of the defect (Figure 1). The width is marked to ensure primary closure of the donor site, and the length can be adjusted after the resection to match the size of the defect. The extension and quality concerning blood supply of the omentum also determine the size of the lotus petal flap and application of either unilateral or bilateral harvest of lotus petal flap(s). An omentoplasty is performed in a standardized manner when the omentum is available. In patients where ELAPE is combined with a distal sacrum or os coccyges resection, the diameter of the defect is significantly larger. Biological mesh,

Figure 1. Variants of the lotus petal flap for reconstruction of the pelvic floor

introduced in our clinical practice in August 2012, is used in major pelvic floor resection, e.g. levator ani en bloc with distal sacrum, and also on the assessment of the surgeon. The biological mesh (Permacol®; Covidien, Mansfield, MA, USA) is used to create extra strength to the newly created pelvic floor and to prevent herniation of the abdominal organs into the pelvic cavity. The mesh is sutured to the pelvic sidewall at the remnants of the levator muscle and presacral fascia.

After resection, the area of the lotus petal flap that will be buried to fill the defect is estimated and deepithelialized. Next, the skin of the flap is incised until the underlying fascia of the muscle is mobilized by elevating the flap, including the fascia, from lateral to medial. During mobilization, the lateral perforators must be sacrificed. More medial large perforators can be encountered and should be treated with care. Closing the donor site will give some extra length to the flap since the pivot point is advanced cranially. A drain is used in each donor site before the skin is closed in layers. If possible, the flap is secured to the periosteum of the inferior pubic ramus or latero-posterior edge of the wound and, in cases where a biological mesh is used, the flap is stitched to the edges of the mesh. In bilateral performance, the second flap is rotated on top of the first flap and then secured to it. At this time is determined whether it is necessary to deepithelialize more skin. In case of posterior vagina wall resection, sometimes the flap can be tunneled and only a proximal part of the flap is deepithelialized, with the distal skin being used to reconstruct the inner lining of the posterior vaginal wall. The skin is closed in layers and finished with suture strips and a dressing (Figure 2, Figure 3).

Postoperatively, pressure and tension on the donor site and resection site wounds was prevented by not allowing the patient to mobilize or flex the hip joints and providing an air fluidized bed (Clinitron®; Hill-Rom, Batesville, IN, USA) for one week. During immobilization the drains stay in situ. During the first three weeks, sitting is prohibited, except for during transfers.

Data collection and analysis

Our defined outcome parameters were complications and time to wound healing to define safety; perineal hernias to define function; and donor site complications and additional surgery, performed for aesthetic reasons, to define form.

We reviewed patient files for patient and tumor characteristics, surgical reports, postoperative complications and time until wound healing. Complications were classified using the Clavien-Dindo classification.

Data were analyzed in a descriptive manner and expressed as number (%) for categorical data. In case of normal distribution, tested with the Shapiro-Wilk test, data were expressed as mean (standard deviation [SD]) or median (range).

Figure 2. 62-year-old male patient

A. Defect after ELAPE with omentoplasty with a biological mesh in situ (black arrow);
B. Lotus petal flap unilaterally marked in the gluteal fold; **C.** Lotus petal flap placed into defect; **D.** Immediately postoperatively
 ELAPE: extralevator abdominoperineal excision

Figure 3. 84-year-old female patient

A. Defect after ELAPE with bilaterally marked lotus petal flap in the gluteal fold;
B. Unilaterally elevated lotus petal flap from the right side and placed into defect;
C. Immediately postoperatively; **D.** Two weeks postoperatively in the decubitus position
 ELAPE: extralevator abdominoperineal excision

RESULTS

Overall, 31 patients underwent reconstruction of the pelvic floor with the lotus petal flap after ELAPE for oncological reasons. Two patients died within three months, and one patient suffered from a dehiscence and underwent surgery for debridement and primary closure of the wound; this patient died of an aspiration four weeks postoperatively. Another patient experienced no complications of the reconstruction but died due to the consequences of a peritoneal carcinomatosis two months postoperatively. Three procedures were excluded because the procedure was performed as a complication of the first procedure. Of these patients, the second procedure was marked as a complication of the first procedure (Clavien-Dindo grade IIIb). A total of 28 patients who underwent 41 flaps were included in this study. The demographics of the patients and the tumor characteristics are shown in Table 1. In 15 (53.6%) cases we performed a unilateral flap, while in the other 13 (46.4%) cases, bilateral flaps were used. We mostly (78.6%) used the gluteal fold as the donor site, or, alternatively, the inguinal fold was used (21.4%). In 12 (54.5%) of the 22 female patients, reconstruction of the vagina was performed.

Table 1. Patient and tumor characteristics

	n (%)	Mean (SD)
Female sex	22 (78.6)	
Age (years)		62.1 (11.7)
Body Mass Index (kg/m ²)		28.1 (5.8)
Smoking	6 (21.4)	
Radiation	26 (92.9)	
ASA classification		
Class I	4 (14.3)	
Class II	21 (75.0)	
Class III	3 (10.7)	
Type of carcinoma		
Rectal	15 (53.6)	
Anal	5 (17.9)	
Vulvar	2 (7.1)	
Vaginal	1 (3.6)	
Cervical	1 (3.6)	
Clear cell endometrial	1 (3.6)	
Ewing sarcoma	1 (3.6)	
Epithelioid sarcoma	1 (3.6)	
Gastrointestinal stromal tumor	1 (3.6)	
T-classification according to TNM		
T1	2 (7.1)	
T2	4 (14.3)	
T3	3 (10.7)	
T4	13 (46.4)	
n/a	6 (21.4)	

ASA: American Society of Anesthesiologists, n/a: not available, SD: standard deviation, TNM: Tumor Node Metastasis

Table 2. Resection and reconstruction details

	Resection procedure	Application/presence of		
		Urostomy	Colostomy	
	n (%)	n (%)	n (%)	
Total study population	-	9 (32.1)	28 (100)	
Split by resection procedure				
ELAPE	8 (28.6)	0 (0.0)	8 (100)	
ELAPE + vaginal wall	7 (25.0)	1 (14.3)	7 (100)	
ELAPE + sacrum	1 (3.6)	0 (0.0)	1 (100)	
Total exenteration	6 (21.4)	6 (100)	6 (100)	
Chronic wound after ELAPE	3 (10.7)	2 (66.7)	3 (100)	
Wide perineal excision	2 (7.1)	0 (0.0)	2 (100)	
Perineal hernia after ELAPE	1 (3.6)	0 (0.0)	1 (100)	

ELAPE: extralevator abdominoperineal excision

Table 3. Complications of the lotus petal flap according to the Clavien-Dindo classification.

Grade	n (%)
0	6 (21.4)
I	11 (39.3)
II	2 (7.1)
IIIa	0 (0.0)
IIIb	9 (32.1)
IVa	0 (0.0)
IVb	0 (0.0)
V	0 (0.0)
No complications (grade 0)	6 (21.4)
Minor complications (grade I-II)	13 (46.4)
Major complications (grade III-V)	9 (32.1)

An additional myocutaneous flap was not required in any of the patients in order to fill the defect. The median length of follow-up was 22.7 months (11.0-49.5). Reconstruction and resection details are shown in Table 2.

Complications were classified using the Clavien-Dindo classification, as shown in Table 3.¹¹ There were no cases of complete flap loss, and six (21.4%) patients did not experience any complications, which were divided into minor (46.4%) and major (32.1%). Thirteen (46.4%) patients had minor complications: 11 (39.3%) suffered from small dehiscences, which were treated conservatively. Two (7.1%) were treated with antibiotics for a wound infection, nine (32.1%)

	Biological mesh	Omento-plasty	Bilateral use of flap	Reconstruction of vaginal wall
	n (%)	n (%)	n (%)	n (%)
	8 (28.6)	22 (78.6)	13 (46.4)	12 (42.9)
	3 (37.5)	6 (75.0)	3 (37.5)	2 (25.0)
	1 (14.3)	6 (85.7)	3 (42.9)	5 (71.4)
	1 (100)	1 (100)	1 (100)	1 (100)
	2 (33.3)	6 (100)	3 (50.0)	3 (50.0)
	0 (0.0)	1 (33.3)	1 (33.3)	0 (0.0)
	0 (0.0)	1 (50.0)	1 (50.0)	1 (50.0)
	1 (100)	1 (100)	1 (100)	0 (0.0)

patients had major complications, and reoperation was performed due to varying reasons. Necrosectomy was performed in five cases: four times due to necrosis of the distal end of the flap, and once because of dehiscences due to necrosis of the omentoplasty. In two cases we performed another lotus petal flap from the contralateral side in order to reconstruct the defect. The other five reoperations included closing a relapse of a perineal defect with a new lotus petal flap, drainage of an abscess collection due to wound dehiscence on the pivot point, correction of an enterovaginal fistula with partial ileoresection and omentoplasty and twice correction of a perineal hernia. Smoking did not have an significant influence on the complication rate ($B=0.386$; $p=0.749$; odds ratio 1.471).

Time until wound healing was determined as the time between the reconstruction and a completely healed wound, i.e. no open skin defect. The median time until wound healing was 14.0 weeks (8.0-51.0).

The presence of a perineal hernia was tested in the standing position. In two patients (7.1%), reoperation was performed because of a perineal hernia, the first of which was found on clinical grounds and computed tomography (CT) imaging had shown no abnormality. The other patient, who had previously undergone necrosectomy, experienced the feeling of pressure, and a mild perineal hernia was seen on magnetic resonance imaging (MRI). After correction of the hernia, the feeling of pressure persisted, presumably caused by phantom syndrome of the anus.

Four (14.2%) patients had minor dehiscence of the donor site; one (3.6%) patient reported a slight numb feeling at the donor site. No additional surgery was performed for aesthetic reasons.

DISCUSSION

The lotus petal flap, based on the rich network of perforating vessels of the internal and external pudendal artery, was originally described by Yii and Niranjan in 1996 and is used to reconstruct vulvar defects after oncological resection.¹² Although it has also been described in perineal defects, it has not yet been described as an application for reconstructing a deep soft tissue defect.^{6,13,14} The bilateral variant as a composite of a deep and superficial flap has been described once before but the results were presented combined with other variants.⁶ Their main focus was to close the skin defect but our main priority is filling the soft tissue defect to prevent complications caused by fluid accumulation, resulting in wound healing problems.^{6,14} By deepithelializing the flap and bilateral use, the extensive soft tissue defects can be filled to prevent complications caused by fluid accumulation, especially combined with omentoplasty. Using the skin and subcutaneous tissue of the gluteal or inguinal fold does not give permanent functional compromise or leave an inconspicuous scar in the fold, and gives no restrictions for future reconstructions.^{12,14,15} This flap can also be performed in obese patients without modifications, shown by a mean body mass index of 28.1 kg/m² (SD 5.8). By using neighboring and therefore similar tissue, although outside the area of tumor spread and irradiation, the flap provides healthy well-vascularized tissue to protect the perineal area. Only the bases of the flaps may have been in the radiation field, especially in anal carcinoma patients where a wider radiation field of the perianal skin is applied. The first principle of an ideal reconstruction, the safety of the flap, is shown in successfully covering the defect, sufficient wound healing, and an acceptable complication rate. We were able to reconstruct all defects, partly as bilateral use (46.4%) and partly combined with omentoplasty (78.6%). In none of the cases was there the need to combine the lotus petal flap with a myocutaneous flap in order to fill the defect. In case of posterior vaginal wall resection and a wish for reconstruction of the vagina, we created a neovagina in more than half of our female patients (54.5%). Time to wound healing is important since long duration of healing extends the woundcare, limits the patient's mobility, and raises the costs. In our opinion, the median time until complete wound healing (14.0 weeks) was sufficient in proportion to the extensiveness of the reconstruction and size of the defect. This duration is probably overestimated since closure at the first follow-up moment (2-3 months postsurgery) was documented as duration of 2-3 months. The main reason of incomplete wound healing was superficial wound dehiscence. The time until wound healing in reconstruction with the lotus petal flap has never been reported in other studies and we think that it should be part of future prospective outcome studies. A recent study on rectus abdominis myocutaneous flap for perineal reconstruction showed more Clavien-Dindo grade I (50%) and grade II (12.5%) complications compared to our study (39.3% and 7.1%, respectively). This study also experienced flap failure in 6% of the cases, where we did not experience complete flap loss at all.¹⁶ Smoking did not have any significant influence on the complication rate, possibly due to the small study population.

In this retrospective study, few donor site complications and no functional problems at the donor site were recorded. In reconstruction using the rectus abdominis myocutaneous flap, donor site herniation was experienced in 19% of cases.¹⁶ The gracilis flap is known for its noticeable donor site scar.^{17,18} With the lotus petal flap, no functional compromises have been made by using skin surplus and subcutaneous tissue. Minor dehiscence was experienced in 15.2% of the patients, where healing by secondary intention occurred. The scars at the donor site will be inconspicuous in the gluteal fold and possible hidden by underwear.^{6,19} In our study, no additional surgery was performed for aesthetic reasons.

The main aspect of the functionality was to strengthen the pelvic floor. Unfortunately, two patients (7.1%) experienced a perineal hernia and another patient experienced a relapse of the perineal defect. In all other cases, the lotus petal flap, in some cases combined with a biological mesh, gave enough strength to the pelvic floor. None of the patients with a biological mesh developed a perineal hernia, which was also reported by Christensen et al.²⁰; however, these investigators experienced perineal hernias in 21% of their cases after reconstruction with just a fasciocutaneous gluteus flap. Therefore, the necessity of application of a lotus petal flap, together with the application of a biological mesh, should be considered in every ELAPE patient. Earlier studies with the rectus abdominis myocutaneous flap did not report perineal hernias but, as described before, had a higher overall complication rate and donor site hernias.^{16,21}

The major weakness of this study was its retrospective design; therefore, our evaluation parameters, such as wound healing problems and other complications, may be underrated and follow-up was not standardized. Although this study gives an overview of results of the application of the lotus petal flap in pelvic floor reconstruction, a prospective cohort study needs to be performed in order to produce a more accurate perspective. Functional parameters such as sexual activity could not be reliably retrieved from the patient files. Questionnaires should be included to investigate the influence on function, quality of life, and patient satisfaction.

Conclusion

Our study demonstrated that reconstruction of pelvic floor defects after ELAPE with the fasciocutaneous lotus petal flap is feasible, and acceptable early complication and wound healing rates were found. Reconstruction of the pelvic floor after ELAPE using the fasciocutaneous lotus petal flap appears to have limited consequences on form and function. The incidence of wound complications is still high, presumably mainly due to large wounds in an irradiated area.

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CHAPTER 6

Quality of life, sexual functioning, and physical functioning following perineal reconstruction with the lotus petal flap

Joke Hellinga
Martin W. Stenekes
Paul M.N. Werker
Moniek Janse
Joke Fleer
Boudewijn van Etten

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ABSTRACT

Background

Lotus petal flaps (LPF) may be used for the reconstruction of extralevator abdominoperineal defects that cannot be closed primarily. Limited data are available on how perineal reconstruction with the LPF impacts on patients' quality of life (QoL), sexual functioning, and physical functioning.

Methods

A cross-sectional study was performed following perineal reconstruction with the LPF. The QoL of patients having undergone LPF reconstruction was compared with a control group in which perineal defects were closed without flaps. Sexual and physical functioning (presence of perineal herniation and range of motion (ROM) of the hip joints) could only be evaluated in the LPF group. Psychometrically sound questionnaires were used. Physical functioning was evaluated subjectively with binary questions and objectively by physical examination.

Results

Of the 23 patients asked to participate, 15 (65%) completed the questionnaires and 11 (47%) underwent physical examination. In the control group, 16 patients were included. There were no significant differences in QoL between the LPF and control groups. Within the LPF group, 33% of patients were sexually active postoperatively compared with 87% preoperatively. No perineal herniation was found. The ROM of the hip joints was bilaterally smaller compared with the generally accepted values.

Conclusions

Conclusions should be made with care given the small sample size. Despite a supposedly larger resection area in the LPF group, QoL was comparable in both groups. Nonetheless, reconstruction seemed to affect sexual function and physical function, not hampering overall satisfaction.

INTRODUCTION

Resection of advanced anal and rectal tumors by means of extralevator abdominoperineal excision (ELAPE) may lead to extensive soft tissue defects in the perineal area.¹ Wound healing may be impaired due to application of neoadjuvant radiotherapy and chemotherapy, especially in patients with advanced cancer and malnutrition.^{1,2} When resulting defects are too large for tension-free primary closure, reconstruction with a soft tissue flap should be performed.^{2,3} Such a reconstruction has the potential for bringing well-vascularized, nonirradiated soft tissue into the defects and is able to fill the dead space and minimizes the risk of fluid collections and infections.^{1,2,4,5} Our first choice of flaps following ELAPE is the lotus petal flap (LPF), a regional flap based on perforators of the internal and external pudendal vessels behind.²⁻⁷ This flap has been widely used for vulvar reconstruction over the past decades, yet the application for perineal reconstruction is relatively new as its use was reported for the first time in 2007.^{6,8-10}

From research on vulvar reconstruction, we know that reconstructive surgery in this area may have a large impact on quality of life (QoL) and sexual functioning.¹¹ However, little or no data are available on how perineal reconstruction with the LPF impacts on patients' lives (i.e. QoL, sexual functioning, and physical functioning). Perineal herniation has been reported as a common complication (incidence rates vary from 1 to 26%) following ELAPE.¹² Reconstruction with a soft tissue flap supposedly lowers the risk of perineal herniation, but currently there are no data available to support this statement.¹³ There are also no data available on the ROM of the ipsilateral hip joint after LPF, whereas it is likely that this procedure influences the function of the hip joint as the LPF donor site is located on the junction of the buttock and the upper thigh and is sometimes quite tight after primary closure.

Therefore, the primary aim of this study was to assess the postoperative QoL of patients who had undergone LPF reconstruction following ELAPE and compare this with a control group in whom primary closure of the perineal defect following abdominoperineal excision (APE) had been possible. The secondary aim was to assess postoperative sexual and physical functioning in both groups. Two aspects of physical functioning had our main interest; first, the presence of perineal herniation, and second, the range of motion (ROM) of the hip joint on the side where the LPF was harvested. Our hypothesis is that QoL in the reconstructive group is higher compared with the control group. Furthermore, we believe that sexual function will be influenced by the reconstruction, but physical functioning will barely be affected.

METHODS

Patients and procedures

The LPF group consisted of patients who underwent perineal reconstruction with the LPF at the University Medical Center Groningen, The Netherlands, between October 2011 and December 2015. Patients who were deceased at the time of follow-up and patients who were not able to read or write Dutch were excluded. Eligible patients received a package containing an information letter, an informed consent form, the questionnaire, and a return envelope. Patients who did not reply within 2 weeks were called by the first author, asking them if they had received the package and asking them to contemplate to return the informed consent and, if applicable, the questionnaire. After QoL data collection was completed, participating patients were asked to visit the outpatient clinic to be physically examined. They were asked to sign informed consent during visit to the clinic.

The historical control group consisted of colorectal cancer patients who had undergone APE and radiotherapy between December 2011 and March 2013 and did not need reconstruction because of the limited size of the resulting defect after tumor resection allowing for primary closure. These patients were selected from a larger study performed by Janse et al. investigating QoL in the first 18 months after colorectal cancer.¹⁴

Measures

Data regarding patient demographics and treatment and disease characteristics were collected from the medical files.

QoL was assessed in both the LPF and the control group using two psychometrically sound questionnaires. The global health status scale and the five functional scales (i.e. physical, role, emotional, cognitive, and social functioning) of the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire C30 (EORTC QLQ-C30) version 3.0 were used to assess general QoL.¹⁵ After transformation, the scores ranged from 0 to 100. In addition, the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire CR29 (EORTC QLQ-CR29), which was specifically developed to assess the QoL of colorectal cancer patients, was used.^{16,17} This questionnaire consists of three functional scales (i.e. body image, anxiety, and weight). After transformation the scores also ranged from 0 to 100.

Sexual functioning and physical functioning were only assessed in the LPF group. The Female Sexual Function Index (FSFI) and the Male Sexual Function Index (MSFI) were used to assess sexual functioning of the female and male patients, respectively.¹⁸⁻²⁰ Only the total score was used (maximum of 36 points). A total score >26 is considered as normal sexual functioning.²¹ In addition, binary questions were used to assess whether or not patients (1) currently had a partner, (2) were

sexually active before surgery, (3) were sexually active after surgery, and (4) had intercourse after surgery. Sexual activity was permitted 6 weeks postoperatively. Postoperative sexual activity was also assessed in the control group.

LPF-specific physical functioning was measured subjectively and objectively. Subjective physical functioning was measured by asking whether or not patients experienced (1) any perineal bulging, reflecting perineal herniation (during sitting, standing or walking), (2) limitations in the use of the left hip (during sitting or walking), (3) limitations in the use of the right hip (during sitting or walking), (4) other limitations during sitting, and (5) limitations during cycling. Objective physical functioning was measured by determination of the active ROM (flexion) in both hips (using a goniometer) according to the standard way of measuring of the American Academy of Orthopaedic Surgeons.²² Of patients with bilateral donor sites, the ROM of both sides was averaged.

The existence of perineal herniation was examined by the first author in both the lateral and standing position. In standing position, the Valsalva maneuver was performed. Postoperative perineal herniation was defined as the protrusion of intra-abdominal viscera through a defect in the pelvic floor into the perineal region. In case of perineal herniation, the extent was estimated as the distance to the normal level of the buttocks.

Data analysis

The IBM Statistical Package for the Social Sciences (SPSS) version 23 was used for the analyses. Data for the LPF group were compared with the control group using the Mann-Whitney U-test or Chi square test. The effect of the reconstruction on the EORTC QLQ-C30 and CR29 data was determined using linear regression. Treatment (reconstruction or no reconstruction) and all significant differences in study characteristics (tumor classification, excision type, type of (chemo) radiotherapy) and time between surgery and receiving back the survey) (Table 1) were included as fixed variables, and the EORTC scale was included as a random variable. A p-value <0.05 was considered statistically significant.

Descriptive data on physical and sexual functioning were reported as n (%) or median (range). In the FSFI/MFSI questionnaires, the domain scores were considered missing in case more than half of the items of that domain were missing, otherwise missing items were replaced by the mean of the known items.

Table 1. Study characteristics

	Lotus petal flap group (n=15)	Control group (n=16)	p Value
Age (years) in mean (SD)	60.4 (13.6)	63.7 (9.9)	0.64
Gender (male) in n (%)	12 (80.0)	11 (68.8)	0.47
Tumor type in n (%)			0.17
Rectal cancer	12 (80.0)	16 (100)	
Anal cancer	2 (13.3)	0 (0)	
Giant condylomata	1 (6.7)	0 (0)	
Tumor classification in n (%)			0.04
T1	2 (13.3)	0 (0)	
T2	3 (20.0)	8 (50.0)	
T3	6 (40.0)	8 (50.0)	
T4	4 (26.7)	0 (0)	
Excision type in n (%)			0.001
APE	0 (0)	16 (100)	
ELAPE	4 (26.7)	0 (0)	
ELAPE + excision sacrum	4 (26.7)	0 (0)	
Total exenteration	4 (26.7)	0 (0)	
Total exenteration + excision sacrum	2 (13.3)	0 (0)	
Total colectomy + rectal amputation	1 (6.7)	0 (0)	
Radiotherapy in n (%)	15 (100)	16 (100)	n/a
Type of (chemo)radiotherapy			0.01
Long course chemoradiation	13 (86.7)	7 (43.8)	
Short course radiotherapy (5x5 Gy)	1 (6.7)	9 (56.3)	
Previous radiotherapy	1 (6.7)	0 (0)	
Time between surgery and survey (months) in median (range)	30.6 (16.4-64.3)	16.1 (13.5-21.2)	<0.001

n/a: statistical analyses could not be performed due to a 100% score in both groups

APE: abdominoperineal excision, ELAPE: extralevator abdominoperineal excision,

SD: standard deviation

RESULTS

Descriptives

Thirty-five patients underwent reconstruction of a perineal defect with LPF between 2011 and 2015. Eleven patients were deceased at the time of study and one patient was excluded because they were not able to read or write Dutch. In total, 23 patients were asked to participate. Fifteen patients (65.2%) returned the questionnaire and 11 of the 23 patients (47.8%) agreed to participate in the

Figure 1. A 55-year-old male patient
A. Defect following ELAPE; **B.** Harvest of lotus petal flap; **C.** Direct post-reconstruction;
D. 11 days post-reconstruction; **E.** 10 weeks post-reconstruction; **F.** 2 years post-reconstruction
 ELAPE: extralevator abdominoperineal excision

physical examination. Figure 1 shows the pre-, inter- and postoperative result of reconstruction with the lotus petal flap in a typical case.

Four patients (26.7%) did not have any postoperative complications; seven patients (46.7%) had a wound dehiscence that healed without further surgical intervention; and four patients (26.7%) had a complication where surgical intervention was required: two patients (13.3%) had partial necrosis of the flap and underwent necrotomy and additional reconstruction with another LPF. The other two patients (13.3%) had an abscess and underwent surgical incision and drainage. No late complications due to radiotherapy were reported.

Table 2. EORTC QLQ-C30 and EORTC QLQ-CR29 scores

	Lotus petal flap group (n=15)		Control group (n=16)		Recon-struction effect (β)	95% CI	P Value
	Median	Range	Median	Range			
EORTC QLQ-C30							
Global health status	66.7	33.3-100	79.2	33.3-100	8.0	-17.0 to 33.0	0.51
Functional scales							
Physical functioning	66.7	26.7-100	80.0	0.0-100	6.7	-19.3 to 32.7	0.60
Role functioning	50.0	16.7-100	83.3	0.0-100	-11.5	-43.8 to 20.7	0.47
Emotional functioning	75.0	25.0-100	95.8	0.0-100	3.7	-32.0 to 39.4	0.83
Cognitive functioning	83.3	16.7-100	83.3	16.7-100	3.3	-29.6 to 36.1	0.84
Social functioning	66.7	16.7-100	100	0.0-100	-6.8	-44.1 to 30.5	0.71
EORTC QLQ-CR29							
Functional scales							
Body image	33.3	0.0-100	77.8	0.0-100	-18.1	-61.5 to 25.3	0.40
Anxiety	66.7	0.0-100	83.3	0.0-100	-18.3	-63.0 to 26.4	0.41
Weight	100	0.0-100	100	0.0-100	-6.0	-44.9 to 32.9	0.76

Footnote: a high score represents a high quality of life or a high level of functioning

Quality of life

The LPF and control groups did not significantly differ in mean age and sex, but patients in the LPF group had significantly larger tumors and had undergone more extensive treatment (Table 1). One female patient also underwent a posterior vaginal wall reconstruction with the LPF. In the control group, no biological mesh was used, while in the LPF group, both an omentoplasty and biological mesh were used as part of reconstruction of the pelvic floor in 10 patients (66.7%). In three patients (20.0%), an omentoplasty only was used, and, in one patient (6.7%) a biological mesh only was used, leaving one patient (6.7%) with neither an omentoplasty nor a biological mesh. No biological mesh-related complications were reported. The LPF group showed a significantly longer time between surgery and the return of the completed survey ($p < 0.001$).

There were no significant differences between both groups in terms of general QoL scores (EORTC QLQ-C30) and colorectal-specific QoL scores (EORTC QLQ-CR29) (Table 2). The global health status and some of the functional scales of the EORTC QLQ-C30 (physical functioning, emotional functioning, and cognitive functioning) showed a positive reconstruction effect. Although those differences were not significant in our small study population, it shows a trend towards higher scores of the LPF group, indicating a higher global health status and a higher quality of physical, emotional, and cognitive functioning in the LPF group. The other functional scales of the EORTC QLQ-C30 (role functioning and social functioning) and the functional scales of the EORTC QLQ-CR29 (body image,

anxiety, and weight) showed a negative reconstruction effect. This shows a trend towards higher scores of the control group, indicating a higher quality of role and social functioning, higher body image, less anxiety, and less weight problems in the control group; however none of these differences were significant in our small study population.

Sexual functioning

In the LPF group, 12 of the 15 patients had a partner (80%) and 13 of the 15 patients were sexually active before surgery (86.7%). Five patients (33.3%), one female and four males, reported to be sexually active postoperatively; all five were also sexually active preoperatively. Four (26.7%) of these patients, one female and three males, had intercourse after surgery. Of the three patients who completed the FSFI/MSFI, the median total score was 16.8 (15.2-30.1). One patient scored above the cut-off point of 26 for normal sexual functioning.

In the control group, nine patients (56.3%), seven males and two females, were sexually active postoperatively.

Lotus petal flaps-specific physical functioning

Six patients underwent a reconstruction with a unilateral (54.5%) LPF, four of whom reported no limitations in hip function on either side. Two patients reported limitations on both sides during sitting. Five patients underwent a bilateral LPF reconstruction (45.5%), one of whom reported no limitations, two reported limitations on both sides during sitting and activities, and two reported limitations on just one side during activities. All except one of the included patients experienced limitations in duration of sitting, varying from 1 to 60 min. Five patients were no longer able to ride a bicycle following reconstruction (three for a limited duration, varying from 2 to 60 min), and three patients experienced no limitations during cycling. During physical testing, the ROM of the LPF group had a median maximum flexion of 105° (range 80-130) and a median maximum (hyper)extension of 10° (range 0-25). No signs of perineal herniation were found in any of the 11 patients who underwent reconstruction.

DISCUSSION

The aim of this study was to evaluate QoL, sexual functioning, and physical functioning following perineal reconstruction using the LPF technique. The main results of our study show that despite the extent of the resection performed in the LPF group, QoL was not significantly different from that of patients with a smaller resection, in whom there was no need for reconstruction using flaps. Earlier studies on perineal reconstruction following resection for rectal cancer compared the use of the vertical rectus abdominis myocutaneous (VRAM) flap with primary closure. Those studies showed no or only small differences between both groups

on the EORTC QLQ-C30 and EORTC QLQ-CR29.^{23,24} QoL studies in the field of oncology often reveal little changes in QoL, and Sprangers and Schwartz explained this phenomenon as response shift, which means that a life-threatening disease, such as cancer, may change a patient's internal standards of self-evaluation.²⁵ Therefore, the experience with cancer may change their expectations about life and, as such, they may evaluate their QoL according to these new expectations and internal standards, resulting in the report of a relatively good QoL despite the large impact of this major life event.²⁵⁻²⁷

The results also indicated that, in retrospect, patients who underwent LPF reported decreased sexual and physical functioning. Moreover, only one patient scored above the cut-off of normal sexual functioning postoperatively. Low sexual functioning could be partially due to the reconstruction, but also the malignant disease itself may have influenced sexual functioning. Low sexual functioning has been reported in earlier studies on preoperative patients diagnosed with colorectal carcinoma, in which the mean and median scores of patients were well below the cut-off of normal sexual functioning.^{28,29} No earlier studies on sexual functioning following LPF reconstruction have been reported. An earlier study on postoperative sexual functioning after perineal resection comparing patients without reconstruction with patients who underwent reconstruction with the VRAM technique showed that the non-reconstruction group had slightly better sexual functioning (mean 21.0 vs 12.9).³⁰ It should be noted though that this study, like ours, was performed in a small group (n=29), which limits the reliability of the findings. However, given the consistency in findings, it does stress the importance of discussing sexual functioning during the preoperative counseling since the reconstruction seemed to have an impact on sexual functioning. Indeed, in their systematic review on sexual function following perineal reconstruction, McArdle et al. also emphasized the importance of preoperative counseling to ensure realistic goals and expectations on postoperative sexual functioning.³¹

Regarding LPF-specific physical functioning, many patients reported limitations during sitting, especially those patients after bilateral use of LPF. The median ROM of the hip (105°) was lower compared with average ROM of healthy people (120°), as published by the American Academy of Orthopaedic Surgeons; however, this degree of flexion is still considered normal and does not cause any impairment.^{22,32} In addition, the hip extension was decreased following LPF reconstruction (10°) compared with untreated people (30°).²² Hypothetically, the donor site on the posterior side of the hip may cause (temporary) tightness of the skin and limit flexion of the hip. In that case, only a decrease in flexion would have been expected. However, in our study group, limitation during both flexion and extension was seen. The decreased ROM (both flexion and extension) could possibly be due to either the radiotherapy or to pain.

During the outpatient clinic visits, no signs of perineal herniation were found in any of the 11 patients. The incidence of perineal herniation following ELAPE without use of a flap ranges from 1 to 26%. Our outcome is comparable with the systematic review of Balla et al. on perineal hernia repair after perineal resection, who also reported low recurrence rates of perineal herniation when a flap was used.¹² Use of an omentoplasty or biological mesh also contributes to the prevention of perineal herniation. Reconstruction using the LPF seems to have a limited influence on the ROM and to prevent perineal herniation.

Limitations

This study had a small study population and a broad range in time between surgery and survey. This is hard to overcome as the application of this reconstruction technique is limited and, in addition, many patients unfortunately have a limited life expectancy following treatment of advanced rectal and anal cancer. Cases in the LPF group had larger defect sizes than those in the control group. This selection bias cannot be avoided. Patients with defects large enough to require reconstruction cannot be closed primarily, and it would be unethical to reconstruct patients when their wound can be closed primarily. However, this is the largest study to date on the subject of QoL and sexual and physical functioning following perineal reconstruction with the LPF. Prospective multicenter studies, with a standardized presurgical assessment on QoL, sexual functioning, and physical functioning, are needed to increase the quality and quantity of data.

Conclusion

LPF reconstruction after extensive perineal resection did not impair QoL when compared to perineal resection without reconstruction, even though the resection size was much larger in the LPF group. Both sexual and physical functioning become, to a certain extent, impaired following LPF reconstruction in the perineal area, although not hampering overall satisfaction, and no cases of perineal herniation were observed.

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CHAPTER 7

Esthetic outcomes of perineal reconstruction with the lotus petal flap

Joke Hellinga

Joke Fleer

Berend van der Lei

Paul M.N. Werker

Boudewijn van Etten

Martin W. Stenekes

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ABSTRACT

Background

The lotus petal flap can be applied for reconstruction of extensive defects in the vulvoperineal area. Studies on esthetic outcome are lacking. This study aimed to fill this gap.

Methods

All patients who underwent lotus petal flap reconstruction between October 2011 and December 2015 were asked permission to have their photographs used. Two questionnaires were used: (1) the Strasser score to assess the overall esthetic result (range 0-15) and (2) the Patient and Observer Scar Assessment Scale (POSAS; range 6-60). Six plastic surgeons and six laymen filled in the Strasser score and the Observer scale of the POSAS. Patients filled in the Strasser score, the Patient scale of the POSAS and scored their overall satisfaction with the esthetic result on a Likert scale (0-10).

Results

The photographs of 11 patients were included. The median Strasser score of all observers of 11.9 (range 0.0-75.0), indicated a mediocre esthetic result. The median total POSAS score of 15.6 (range 6.0-41.0), indicated an esthetically acceptable scar. Strasser and POSAS scores of the plastic surgeons and laymen did not differ significantly from the patients' scores. The patient satisfaction score with the esthetic result was a median of 6.0 out of 10.

Conclusions

The findings indicate that, overall, patients were moderately satisfied with the esthetic result of their lotus petal flap reconstruction, as were the plastic surgeons and laymen. For clinical practice, it is important that the plastic surgeon manages expectations carefully before surgery, as it is possible that patients might experience a rather low esthetic outcome after perineal reconstruction.

INTRODUCTION

The lotus petal flap (LPF) is our workhorse for the reconstruction of vulvar and perineal defects, especially after extensive resection (i.e. abdominoperineal excision) of malignant lesions in the perineal region.^{1,2} The LPF is a fasciocutaneous flap based on the rich network of perforating vessels of the internal and external pudendal arteries. The name is derived from the fact that all different options for petals together resemble the petals of the lotus flower.^{1,2} Figure 1 shows the operative steps of perineal reconstruction with the LPF technique. Over the last decades resections in this area seem to have become more extensive and often include resection of part of the levator ani muscle or part of the perineum and vagina. This has significantly improved the oncological outcomes, as indicated by lower local recurrence rates.^{3,4} Because of the improved oncological outcomes, along with the earlier diagnosis, patients after treatment of malignant lesions in the perineal area live longer.

Insights regarding the impact of LPF reconstruction on the quality of life are crucial in order to optimize implementation of the reconstruction technique, but data concerning this aspect are scarce.⁵ Recently, the first results on quality of life and sexual functioning following vulvar reconstruction with the LPF technique were published by our group.⁶ This study showed a lower quality of life following reconstruction compared with healthy women and, although that patients experienced more pain during sexual activity following reconstruction, they reported to be satisfied with their sexual functioning. Another study of our team on perineal reconstruction with the LPF technique indicated that the quality of life of this patient population was not impaired by reconstruction with the LPF, but their sexual and physical functioning were.⁷ Interestingly, even though sexual and physical functioning scored lower, this did not influence the general patient satisfaction with their LPF reconstruction. The ideal perineal reconstruction, however, should not only result in a functionally satisfying result, but should also be esthetically satisfying.⁸ In reconstructive surgery, the esthetic result is an important aspect in patient satisfaction and in improving the self-image of the patient. Moreover, a good esthetic result can positively influence the quality of life.^{9,10} Providing information on the esthetic result and its possible influence on patient satisfaction and self-image are important when obtaining informed consent in the preoperative setting.

The aim of this study is to investigate the esthetic outcome following reconstruction with the LPF from the perspective of the patients, laymen, and plastic surgeons and to investigate the patient satisfaction with the esthetic outcome. To our knowledge, we are the first group to report data regarding the esthetic outcome following reconstruction of the perineal area with the LPF technique. Because no specific scoring instruments are available for scoring of the esthetic results in the perineal area, we used general scoring questionnaires to study the esthetic outcome and patient satisfaction. Next to evaluation of the esthetic results after LPF reconstruction in the perineal region judged by the patients, we also evaluated the esthetic outcome judged by plastic surgeons and laymen. The plastic surgeons use their professional view to judge the esthetic result. Their experience is used during preoperative counseling; therefore, it is important for plastic surgeons to know how their own opinion relates to the patients' opinion on the esthetic outcome. The laymen have the most objective opinion on the esthetic outcome; they are not biased by their personal experience or their professional experience and knowledge, as such giving the best impression of how the general population observes the esthetic outcomes of LPF reconstruction.

METHODS

Participants and procedure

Eligible as subjects for this cross-sectional study on esthetic outcome were all patients who underwent an extensive perineal resection necessitating an LPF procedure for reconstruction between October 2011 and December 2015 at the University Medical Center Groningen (UMCG). Exclusion criteria were: no knowledge of the Dutch language, cognitive impairment, and known recurrence of the disease. They were sent an information letter, an informed consent form, and the questionnaires. They were also invited to have photographs taken of their LPF reconstruction by our medical photographer (Figure 2). Only patients who gave written informed consent were included in the study.

Six plastic surgeons from the UMCG (three female and three male; mean age of 44.2 years (SD 7.1)), experienced in the LPF procedure, were asked to give their opinion on the esthetic result. These plastic surgeons also performed the LPF procedure of the patients in the patient group. Six non-medically trained persons, matched on gender and age (mean age of 44.0 years (SD 12.1)) with the plastic surgeons, were asked to participate in the layman group. All plastic surgeons and laymen gave oral informed consent. The medical ethical committee of the UMCG decided that formal ethical approval for this study was unnecessary (M17.206526).

Figure 2. Overview of assessment tools

Figure 3. Photographs of a patient 41 months postoperatively
A. Frontal view; **B.** Right side view; **C.** Back view; **D.** Left side view; **E.** Standing view while bending over; **F.** Lithotomy position view

Six photographs of each patient were taken while standing: a frontal view, a back view, a view of each side, a lithotomy position view, and a standing view while bending over (Figure 3). The photographs were anonymized and collated into a powerpoint presentation in random order per patient to be assessed by the plastic surgeon and layman group. Every plastic surgeon and layman scored every patient based on the six photographs per patient. The patients group only judged him or herself (without the photographs).

Scales

An overview of the assessment tools is provided in Figure 2. The esthetic result of the reconstruction was objectified using the Strasser questionnaire and the Patient

and Observer Scar Assessment Scale (POSAS).^{11,12} The Strasser questionnaire was used to grade the esthetic surgical results based on five flaws or deficiencies: malposition, distortion, asymmetry, contour deformity, and the scar. They can each be scored as 'perfect' (0 points), 'noticeable' (1 point), 'obvious' (5 points), or 'obvious and deforming' (15 points). The total score is the sum of all five scores. Zero points means an excellent esthetic result, 1-4 points is a good esthetic result, 5-14 points a mediocre esthetic result, and 15 points and up is a poor esthetic result.

POSAS was used to assess the esthetic result of the scars resulting from reconstruction with the LPF. The POSAS has two parts: a Patient scale and an Observer scale. The Patient scale has six items: pain, itching, color, pliability, thickness, and relief of the scar. The Observer scale also has six items: vascularity, pigmentation, pliability, thickness, relief, and surface of the scar. Each item is scored from 1 (normal skin) to 10 (worst imaginable scar). The total score of all six items together ranges from 6 to 60. The overall opinion is scored with an item ranging from 1 to 10. A low score indicates a scar result close to normal skin. No difference is made between the scar of the donor site and acceptor site.

The overall patient satisfaction with the esthetic result of their LPF reconstruction was measured was using a 10-point Likert scale ranging from low satisfaction (0) to high satisfaction (10). Data on patient demographics and reconstruction characteristics were collected using their medical files.

Data analysis

Data analysis was performed using IBM Statistical Package for the Social Sciences, version 23 (IBM Corp., Armonk, N.Y.).

Categorical data were described as number (%), and continuous data as mean (SD) in case of normal distribution and median (range) for non-normal distributed data. Results of the questionnaires and the Likert scale were described as median (range), because of the small sample size. In case of one missing item score, the mean imputation method was applied to calculate the total score. For comparison of the results of the questionnaires between the patient, plastic surgeon and layman group the Kruskal Wallis test was applied. The influence of the esthetic outcome, scored on the questionnaires, on the satisfaction with the esthetic result $P < 0.05$ was considered significant.

RESULTS

Participant characteristics

Between October 2011 and December 2015, 35 patients underwent perineal reconstruction with the LPF at the UMCG. Eleven patients had died at the time of

Figure 4. Flow chart of the study population

this study. Twenty-four questionnaires were sent out and, 21 patients responded (87.5%). Six patients did not want to participate in the study, one patient did not understand the Dutch language, two patients had a known recurrence of the disease, and one patient was unable to fill out the questionnaire due to cognitive impairment. The remaining eleven patients were included in this study, three women and eight men (Figure 4). The mean age at time of study was 56.6 years old (SD 13.7) and the median time from reconstruction was 2.6 years (range 1.4-5.4). Most patients ($n=9$, 81.8%) had a rectal carcinoma, and the other two (18.2%) an anal carcinoma.

All patients but one (90.9%) received neoadjuvant chemo-radiotherapy. This patient (9.1%) received postoperative radiotherapy only. A biological mesh was applied to reconstruct the pelvic floor in eight (72.7%) patients, and an omentoplasty in ten (90.9%) patients. Reconstruction was performed with a unilateral (54.5%) or bilateral (45.5%) LPE. No comparison analysis is performed between the unilateral and bilateral group because of the small sample size. Complications of the donor site occurred in five (45.5%) patients. These were all minor complications (Clavien Dindo grade I or II).¹³ Complications of the recipient site occurred in seven (63.6%) patients. In five (45.5%) patients, these were minor complications (Clavien Dindo

Table 1. Strasser scores per group

Case number	Patient		Surgeon		Layman	
	Score	Category	Median (range)	Category	Median (range)	Category
1	0	Excellent	19.0 (4-31)	Poor	9.0 (3-17)	Mediocre
2	2	Good	10.5 (1-25)	Mediocre	17.0 (9-37)	Poor
3	5	Mediocre	31.5 (8-61)	Poor	19.0 (4-31)	Poor
4	7	Mediocre	18.5 (13-55)	Poor	30.0 (8-55)	Poor
5	75	Poor	13.0 (3-55)	Mediocre	20.5 (9-55)	Poor
6	9	Mediocre	5.0 (1-17)	Mediocre	6.0 (4-41)	Mediocre
7	25	Poor	15.0 (4-35)	Poor	19.0 (2-61)	Poor
8	16	Poor	15.0 (5-45)	Poor	13.0 (2-21)	Mediocre
9	31	Poor	9.0 (3-21)	Mediocre	5.0 (4-17)	Mediocre
10	1	Good	2.5 (0-21)	Good	5.0 (0-21)	Mediocre
11	5	Mediocre	6.0 (2-45)	Mediocre	7.0 (3-31)	Mediocre
Total	7 (0-75)*	Mediocre	12.2 (8-32)	Mediocre	14.7 (10-23)	Mediocre

A low score indicates an excellent esthetic surgical result.

* median (range)

Categories: 0 point: excellent result; 1-4 points: good result; 5-14 points: mediocre result; 15 points and up: poor result

grade I), but in two (18.2%) patients major complications (Clavien Dindo grade IIIb), necessitating surgical debridement in the OR.

Esthetic result scored by the Strasser questionnaire

The patient, the plastic surgeon, and the layman group had a median score of respectively 7 (0-75), 12.2 (8-32), and 14.7 (10-23). The scores in all three groups were categorized as a mediocre result. The results per case are shown in Table 1. At groups level, there were no significant differences between the scores of the three groups ($p=0.325$).

Result of the POSAS questionnaire

The patient group scored a median total score of 14 (6-41) of 60. On the Observer scale of the POSAS questionnaire, the plastic surgeon and layman group scored a median total score of respectively 13.6 (10-22) and 19.5 (12-25) of 60. Those results indicate a scar 'relatively close to normal skin', since a score of 6 of 60 is seen as normal skin. The results of each case are shown in Table 2. There were no significant differences between the three groups concerning the total scores of the POSAS questionnaire ($p=0.506$).

Table 2. POSAS total score per group

Case number	Patient	Surgeon	Layman
	Score	Median (range)	Median (range)
1	6	14.5 (13-17)	20.5 (11-27)
2	14	17.0 (13-37)	25.5 (18-33)
3	10	12.0 (9-20)	15.5 (7-31)
4	22	14.0 (7-15)	22.0 (7-35)
5	26	19.0 (9-34)	34.5 (17-40)
6	12	9.5 (6-12)	10.0 (6-20)
7	30	15.5 (11-24)	14.0 (12-27)
8	20	13.0 (9-17)	16.5 (12-27)
9	6	14.0 (6-48)	15.5 (12-25)
10	8	14.0 (6-32)	17.0 (6-31)
11	41	8.5 (6-12)	12.5 (6-27)
Total	14 (6-41)*	13.6 (10-22)	19.5 (12-25)

A lower score indicates a result close to normal skin.

* median (range)

Besides the total score, also the overall opinion item score of the POSAS questionnaire was given by all three groups. On the Patient scale of the POSAS questionnaire, the patient group gave their overall appearance a median score of 5 (1-8) of 10. On the Observer scale of the POSAS questionnaire, the plastic surgeon and layman group gave the overall appearance a median score of respectively 2.5 (2-3) and 3.6 (2-4) out of 10. The results of each case are shown in Table 3. Although the patient overall appearance score was higher than the score of the plastic surgeon and layman group, this difference was not significant ($p=0.286$).

Patient satisfaction with the esthetic result

The satisfaction of the patients with the esthetic result was scored using a Likert scale. The patient group scored a median of 6.0 (range 0.5-10.0) out of 10. There was no significant correlation between the patient satisfaction and the patient score on the Strasser score ($r=-0.255$; $p=0.449$), POSAS total score ($r=-0.213$; $p=0.529$), and the POSAS overall opinion item score ($r=-0.333$; $p=0.316$), indicating that patient satisfaction with the esthetic result was independent of the grading of the esthetic surgical result and the scar.

Table 3. POSAS overall opinion item score per group

Case number	Patient	Surgeon	Layman
	Score	Median (range)	Median (range)
1	2	3.0 (1-3)	3.5 (2-7)
2	3	3.0 (2-4)	5.0 (3-7)
3	5	2.0 (1-4)	4.0 (1-7)
4	8	2.5 (2-4)	4.5 (1-6)
5	8	4.0 (2-6)	6.0 (3-7)
6	6	2.0 (1-2)	1.5 (1-3)
7	5	2.0 (2-3)	2.5 (2-5)
8	1	2.0 (2-3)	3.0 (2-5)
9	2	2.5 (1-7)	2.5 (2-4)
10	1	2.5 (1-5)	2.5 (1-5)
11	7	1.5 (1-2)	2.0 (1-4)
Total	5 (1-8)*	2.5 (2-3)	3.6 (2-4)

A lower score indicates a result close to normal skin.

* median (range)

DISCUSSION

This study evaluated the esthetic outcome of 11 major perineal reconstructions with the LPF flap, seen through the eyes of 3 stakeholders: the patient, the plastic surgeon, and the layman. The esthetic surgical result as judged by the patients using Strasser was mediocre; however, the esthetic result of specifically the scars using POSAS was 'relatively close to normal skin'. Also, the results clearly demonstrate a moderate overall patient satisfaction, indicating that the patient satisfaction with the esthetic result does not depend on the grading of the esthetic surgical result. Patients' scores of both questionnaires did not differ significantly from those of the plastic surgeons and laymen, indicating that the opinion of all groups are comparable.

To date, only one study reported results on the esthetic outcomes following perineal reconstruction, for which the inferior gluteal artery musculocutaneous transposition flap was applied. In this study, patients were asked for their opinion about the esthetic results of their reconstruction. Upon subjective questioning, they rated their outcomes as good.³ It should be noted that in literature the POSAS questionnaire has mostly been applied for the evaluation of smaller reconstructions. The Strasser questionnaire is mainly applied following facial

and breast reconstruction.^{14,15} The extent of the defect, in which LPF is applied, is much larger. A dedicated validated questionnaire for esthetic outcome following extensive reconstruction, as is the case with an LPF reconstruction, unfortunately is currently not available. Besides, earlier studies also showed that, although the Strasser questionnaire was the best available option, it is, especially in larger reconstructions, unable to discriminate between clinically clearly different esthetic results. The scoring system is very stringent and a small flaw already leads to a poor or mediocre esthetic result.¹⁶

Patient satisfaction is an important factor for determining treatment success. Creating realistic expectations beforehand is of great importance for a high satisfaction afterwards.^{8,17} Only studying the opinion of surgeons regarding the esthetic outcome of a reconstruction will ignore aspects that are of importance to patients.¹⁷ The patient's opinion not only extends beyond cosmetics, the experience during the whole treatment influences their satisfaction.¹⁸ Despite the rather mediocre esthetic surgical result following LPF reconstruction as judged by all assessors using the questionnaires, it stands that most patients were overall moderately satisfied with the esthetic outcome. The patient's satisfaction with the esthetic outcome seemed to be independent of the esthetic surgical result as scored by the questionnaires. The Strasser and POSAS questionnaires are mostly used following smaller reconstructions, in which small flaws may be less conspicuous, while a major resection and a flap by definition causes a major flaw in esthetic result, which will significantly lower the score of the questionnaire. Patients probably take the extent of the reconstruction in account while grading their satisfaction with the esthetic result. This could be the reason that the satisfaction of the patients with the esthetic result is higher compared with the scores on the questionnaires.

Our study did not find a significant difference between the scores regarding the esthetic outcome of plastic surgeons and those scores of the patients probably due to the small sample size. In two previous studies, patients and surgeons were asked to score their satisfaction with the esthetic outcome of respectively nasal and breast reconstruction in a slightly larger study population. Both studies showed that patients were more satisfied with the esthetic outcomes when compared with the surgeons.^{8,17} In our study we did not score the overall satisfaction of the plastic surgeons with the esthetic outcomes, but we rather asked them to evaluate the esthetic surgical result and the scars of the LPF reconstruction using the questionnaires. This evaluation does not reflect an overall satisfaction with the esthetic outcome. This is affirmed by the result that we found no significant correlation between patient satisfaction and the scores of the patients on the questionnaires.

Patients have to deal with the reactions of their (intimate) environment regarding the esthetic outcome of plastic surgery.⁸ In general, laymen tend to be more positive

about the esthetic outcome compared with patients and surgeons.^{19,20} In our study, however, this difference was not found to be statistically significant possibly due to our small sample size. Other than the facial and breast reconstruction in previous studies, the location of the reconstruction site in our study has a limited visibility. The intimate location of the reconstruction site or the extensiveness of the reconstruction could also play a role in the judgment of the laymen.

Strength and limitations

A strength of this pilot study is the provision of a structured impression on the esthetic outcome following LPF reconstruction from the point of view of the patients, plastic surgeons and laymen. Esthetic outcome has never been reported before after LPF reconstructions of the perineal area. An important limitation of the study is that the questionnaires we used were not specifically tailored for evaluation after perineal reconstruction, but better alternatives are currently lacking. Another shortcoming of this study is the limited number of patients due to the low incidence of the procedure and the low survival rate in our patient group because of the extensiveness of the disease. This may also lead to the broad range seen in the results of the questionnaires and the Likert scale. Lastly, the plastic surgeons were all surgeons performing the LPF procedure themselves. This may have limited their objectiveness; however, the advantage is that they were all familiar with the procedure itself and the possible reconstructive outcomes.

Conclusion

This study illustrates that patients score the esthetic surgical result of their perineal reconstruction with the LPF as rather low, but the scars as fairly good. However, those results are independent of the overall patient satisfaction, which is considered reasonable following LPF reconstruction. No differences between the grading of the esthetic outcome among patients, plastic surgeons and laymen were found.

Further studies should focus on developing a better standardized questionnaire for evaluating the esthetic outcome after perineal reconstruction. This will enable us to compare the results of different reconstruction techniques and possibly give a better insight regarding the experienced and observed esthetic outcome. For clinical practice, it is important that the plastic surgeon manages expectations carefully before surgery, as it is possible that patients might experience a rather low esthetic outcome after perineal reconstruction.

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CHAPTER 8

Summary, general discussion and future perspectives

The main aim of this thesis was to study the outcome of vulvoperineal reconstruction with the lotus petal flap (LPF) technique in terms of quality of life (QoL), sexual function, and esthetics. This chapter summarizes the findings of the studies performed, discusses those findings and gives implications for future research.

SUMMARY

Chapter 1 is the general introduction of this research and includes the general aim and outline. The subsequent chapters have been divided in two parts.

In **Part I** we studied vulvoperineal reconstruction. **Chapter 2** systematically reviewed the complications reported following vertical rectus abdominis myocutaneous (VRAM) flap and LPF reconstruction. This review showed that more studies were performed applying VRAM flap reconstruction compared to LPF. Most studies were small, but considered of fair quality. Overall, the studies showed lower complication rates following LPF reconstruction compared to VRAM flap reconstruction, for both the donor and the recipient site. Mainly based on the lower complication rates, it was concluded that LPF reconstruction is the preferred method for vulvoperineal reconstruction. **Chapter 3** is a retrospective study on the complications following LPF reconstruction in our clinic in 93 cases. Almost 70% of the patients experienced complications of some sort. Complications were arranged by the Clavien-Dindo Classification to show the impact of the complications. Most complications were minor (51.7%). Complication rates between vulvar and perineal reconstruction did not differ.

In **Chapter 4** we studied the QoL and sexual functioning following vulvar reconstruction with the LPF. The QoL following reconstruction was lower compared to that of healthy women, but comparable to patients following vulvar cancer surgery without reconstruction. The sexual functioning is reported to be worse compared to healthy women, especially because of pain. Despite this, patients were satisfied with their sexual functioning.

Part II of this thesis focused on perineal reconstruction with the LPF. **Chapter 5** described experiences with the LPF for the application of perineal reconstruction. The study showed that the LPF was feasible for covering defects in the perineal area and had limited disadvantages regarding form and function of the area. The number of complications was high, though they were mostly minor complications according to the Clavien-Dindo classification. Considering the extensive reconstructive procedure in a frequently irradiated area, this was found to be acceptable. Also, the time until wound healing was found to be acceptable. **Chapter 6** focused on the QoL, sexual and physical functioning following perineal reconstruction with the LPF. The study showed no significant differences in QoL between the control group without LPF and the group with LPF reconstruction.

Tendency towards differences were seen, but none were significant, probably due to the small study groups. One-third of the study population was sexually active postoperatively, whereas most patients had been sexually active before surgery. The physical functioning became impaired and varied widely between patients. Despite the decreased sexual and physical functioning, patients reported a high satisfaction rate. In **Chapter 7** we studied the esthetic outcome of perineal reconstruction with the LPF. Until now, this aspect of postoperative results has not received a lot of attention and therefore we found it rather difficult to find adequate measuring tools. Patients were moderately satisfied with the results of the reconstruction. The patients did not grade the results significantly different from the plastic surgeons and laymen.

GENERAL DISCUSSION

This study showed that LPF can be successfully applied to a wide variety of vulvoperineal defects and that the outcome in terms of number and severity of complications as well as in terms of QoL, sexuality and esthetics is acceptable. The versatility of the LPF allows for its wide application, therefore the LPF can be applied in a great variety of cases and this heterogeneity makes it hard to compare. The characteristics of the study group varied not only in terms of the indication for treatment, but also concerning neoadjuvant and adjuvant therapies (e.g. application of radiotherapy or chemotherapy). On top of the wide range of indications for the LPF, our study groups were relatively small because of the low incidence of defects in the perineal area and, unfortunately, the limited life expectancy. For future research, one way to create a more homogeneous study group would be to either make a sub selection by indication or collect data from more than one center. The first option creates even smaller study groups where study groups are already small. The second option would need a protocolled approach from diagnosis to decision of resection and reconstruction. To create this protocolled approach, which is widely applied in breast cancer care, multidisciplinary team meetings are essential. All team members involved in the treatment process of the patients (e.g. oncological surgeon, gynecological surgeon, plastic surgeon, specialized nurse, radiotherapist, medical oncologist) would have a preoperative meeting when the diagnosis is made to decide which neoadjuvant treatment, resection and possible reconstruction needs to be performed. There would also be a postoperative meeting with the pathologist, when the pathology specimen results are definitive, to decide the adjuvant treatment. A recent systematic review on multidisciplinary team meetings for gastrointestinal cancer patients shows changes in treatment and another study with colorectal cancer patients suggest even a slight increase in survival.^{1,2} The multidisciplinary approach shown in the research of this thesis could, therefore, also be a solid base of a multidisciplinary team approach for vulvoperineal cancer patients.

In Chapter 2 we found rather high complication rates following LPF construction, however, still lower in comparison to VRAM flap reconstruction. As mentioned in Chapter 1, the vulvoperineal area has a high risk of wound healing complications, together with patient factors (e.g. advanced disease, chemo- or radiotherapy, smoking, comorbidities) and the extensiveness of the resection and reconstruction, a high complication rate is expected. The rates in this thesis seem to be higher compared to other studies; however, we used the Clavien-Dindo classification to report the complication rates.³ The Clavien-Dindo classification is known to show the impact the complication has on the patient.⁴ Also, the Clavien-Dindo classification reports minor complications (e.g. wound dehiscence), which may seem minor, but certainly can have an impact on the patients' well-being through a longer hospitalization period and more outpatient clinic visits.⁵ One way to downsize the impact on the patients is to manage the wound problems (like wound dehiscence or wound infection) by a (specialized) wound nurse outside the clinic. A support network between the hospital and the wound nurse at home could possibly decrease the number of outpatient clinic visits and improve the duration of wound problems.⁶ The last few years this was set up in our hospital and will expand further in the coming years. A short hospitalization period and decrease of outpatient clinic visits will decrease the health care costs.⁵ Reporting the complications by the Clavien-Dindo classification not only showed impact on the patient and prevented underreporting of minor complications, but also facilitates easier comparison with other studies in the future. To date, most studies on LPF were of very limited size or even case studies, in which no classification system was applied.

In Chapter 3 we compared the complications following vulvar and perineal reconstruction and found no significant differences between both reconstruction areas concerning the amount of complications. Therefore, the complications for the whole study group were reported. The only risk factor for complications we found was that patients younger than 60 years of age experienced more complications in comparison to patients older than 60 years of age. We did not find an explanation for this other than a slightly younger age of patients with perineal tumors in comparison to patients with vulvar tumors and a slightly higher complication rate in the group of patients with perineal tumors. However, all of those differences were not found to be significant. Despite the large study group, especially in comparison to earlier studies on LPF, smoking was not found to negatively influence wound healing. However, smoking is a well-known important risk factor for delayed wound healing.⁷ The reason that smoking was not found to negatively influence wound healing in patients following reconstruction with the LPF could be the still rather small study groups, despite the clearly larger group size compared to earlier studies on LPF reconstruction.

Another issue in studying outcomes of a reconstructive procedure is the fact that studying the outcome of the reconstructive procedure alone is virtually impossible.

However, measuring differences between possible reconstruction options is important when multiple reconstruction options are available. Most outcome measurement tools measure the influence of the resection procedure and the reconstructive procedure together and also the influence of the disease itself. The disease will influence the patients not only physically, but also mentally. Besides, the phenomenon called response shift may be present in oncological patients.^{8,9} The experience of the life-threatening disease may change the patient's internal standards of self-evaluation. This may change their expectations about life and evaluate the outcome measurements following surgical treatment with other adapted standards, compared to outcome measurements measured right after diagnosis. This may result in relatively good outcome measurements despite the life-threatening disease and extensive treatment they underwent.^{8,9} Part of this problem could be solved by prospective studies in which a preoperative assessment can be compared with the postoperative assessment. Even the influence of the disease could be (partly) measured by an assessment at the time of diagnosis and an assessment right before the surgical treatment. However, the difference between the influence of the resection and the influence of the reconstruction on the outcomes is hard to measure. Comparison of the outcomes of a patient group with just the resection procedure to a patient group with resection and reconstruction procedure is not a completely fair comparison. The defects of patients who do not need a reconstruction following resection are clearly smaller compared to patients who do need a reconstruction following resection. The larger defect is mostly the result of a larger tumor and might also influence the non-surgical treatment. All those factors together make comparison not completely fair, but sometimes the only option. It is important to realize that the separate influences of the resection and reconstruction is not important to the patients. If the expected defect has a certain extent the question is not whether or not a reconstruction should be performed, the question is whether or not the surgery (including reconstruction) should take place at all. Therefore, the outcome measurements of the complete surgical treatment are the most important to the patient, while we, as medical professionals, would also be interested in the added value of the reconstructive procedure itself. Of course, both the medical professional and the patient share the common interest in reaching the best result possible.

Most outcome measurements in this thesis were collected using questionnaires. The quality of these questionnaires varies considerably. The general QoL was measured using the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire C30 (EORTC QLQ-C30) in Chapters 4 and 5. The EORTC QLQ-CR29 was used to measure the QoL of specifically the colorectal cancer patients in Chapter 5. The sexual functioning was measured with the Female Sexual Function Index (FSFI) in Chapter 4 and 5 and the Male Sexual Function Index (MSFI) in Chapter 5. The Body Image Scale (BIS) was used to measure the body image in Chapter 4. The esthetic surgical result was measured with the Strasser questionnaire in Chapter 7 and for the esthetic result of the scars we used the

Patient and Observer Scar Assessment Scale (POSAS) in Chapter 7. The 10-point Likert scale for satisfaction regarding functional and esthetic outcome was used in Chapter 4 and for the satisfaction regarding esthetic result in Chapter 7.

The QoL questionnaires, EORTC QLQ-C30 and EORTC QLQ-CR29, are validated disease-specific questionnaires, which are widely applied and translated into many languages.¹⁰⁻¹² The broadly accepted application of these questionnaires enables comparison between different studies. Chapters 4 and 5 showed that LPF reconstruction did not greatly decrease the QoL since QoL of patients following reconstruction was comparable to patients without reconstruction, despite the difference in size of the defect. The earlier mentioned phenomenon of response shift may have influenced those outcomes. However, most important is still the QoL experienced by the patient. The questionnaires used to measure sexual functioning, FSFI and MFSI, are also validated questionnaires and, especially the FSFI, is widely accepted and applied.¹³⁻¹⁵ The FSFI questionnaire could be applied for studying sexual functioning of patients following vulvar reconstruction, however, the patient groups following perineal reconstruction also contains male patients. Therefore, we chose to make a combination of the FSFI and MFSI questionnaire to be able to study sexual functioning in this group as well. We found that a major portion of the patients were not sexually active post-surgery. Not sexually active patients were not able to participate in this questionnaire; therefore the study groups became small. Because sexual activity has not yet been broadly studied following resection without reconstruction, comparison with other studies was limited. The most important finding was that despite the fact that patients seemed to have more pain during sexual activity post-surgery, this did not negatively affect their satisfaction with their sexual functioning. Other studies following reconstruction in the vulvoperineal area with, for example the VRAM flap, report even lower rates of sexual activity post-surgery.¹⁶ Therefore, it is hard to explain why patients are still satisfied with their sexual functioning despite the increased pain during sexual activity. An explanation could be the earlier mentioned phenomenon of response shift in which the expectations of the patients are changed by their oncological diagnosis. Satisfaction rates have been found to improve by a thorough counseling preoperative to set realistic expectations of the outcomes following reconstruction.¹⁷ The most issues we had were to adequately measure the esthetic outcomes following reconstruction with the LPF. For the area of reconstruction no validated questionnaires were available. We applied the Strasser questionnaire and the POSAS in Chapter 7. The POSAS only judges the scars, where this type of reconstruction is more extended than just the scars on the outside and the scars are mainly hidden by clothing.¹⁸ The Strasser questionnaire judges more of the complete picture of the reconstruction: it scores the malposition, distortion, asymmetry, contour deformity and the scar.¹⁹ However, considering the extent of LPF reconstructions, the questionnaire is very strict. Following the reconstruction of extensive defects, small flaws may be expected. But in the Strasser questionnaire a small flaw leads to a high score, where the rating goes from 0 to 1 to 5 and 15 with a maximum score of 75.

Table 1. Strasser scores per group

Group	Strasser score	'Modified' Strasser score
	Median (range)	Median (range)
Patient	7.00 (0.00-75.00)	5.00 (0.00-15.00)
Surgeon	12.23 (8.00-32.09)	6.14 (4.64-10.27)
Layman	14.68 (10.18-22.55)	7.09 (5.55-8.00)

However, when converting this scoring system to simply 0-1-2-3 and a maximum score of 15, the results barely change, taking into account that the maximum score goes from 75 to 15 in the modified scoring system. Table 1 shows the 'original' Strasser scoring system and our modified Strasser scoring system. The results even show slightly worse outcomes compared to prior to modification. The scores of all groups are between 5 and 7 out of 15 following modification (about one-third of the scoring range), where prior to modification all scores are under the one-third of the scoring range (25 out of 75). The strict scoring system of the Strasser questionnaire therefore does not explain the rather moderate outcome of the esthetic result. One idea to create a more valuable outcome measuring system for the vulvoperineal area could be to join already existing initiatives who create esthetic outcome questionnaires like the qportfolio.²⁰ The widely used BREAST-Q questionnaire for the esthetic results of breast reconstruction is developed by the qportfolio initiative. Those questionnaires do not only score the satisfaction of the patient with the result but also take the QoL and expectations into account.²¹ However, only patients are able to fill out the questionnaires and therefore no comparison of the opinion of laymen and surgeons could be made.

The final measurement tool we reported is the 10-point Likert scale. This tool is used to rate the satisfaction of patients with the functional or esthetic outcome. Rating the satisfaction of the patient is probably the most important outcome measurement to perform and creates a helicopter view of all other outcomes measured. Patients will take everything into account when rating their satisfaction including communication, and esthetic result. The Likert scale is a tool which is easy for the patient to understand since it is comparable to the grading scale used in school. It is also quick and easy to perform. Notable, the esthetic outcome that was graded did not correspond completely with the satisfaction of the patients with the esthetic result. This was similar to the example of when the low sexual function did not correlate with the high satisfaction rate with the sexual function. Despite moderate results, patients seem to be satisfied with the result, probably due to lowered expectations as mentioned earlier. At the end, the satisfaction of the patient is the most important outcome factor.

An important consequence of the retrospective nature of the studies reported in this thesis is that pre-operative data are missing. However, most outcome measurements we reported were never studied before following reconstruction with the LPF. The first step to gain information on those outcome factors is to perform a retrospective study. Those studies help to design prospective studies to be performed in the future and can provide the next generation of patients with information. However, known disadvantages of retrospective studies which are seen in this thesis are a non standardized follow-up which, in our thesis, lead to a wide range in duration of follow-up. Also, inconsistency of reporting data is an issue, especially underreporting of minor complications since those are not always reported. We tried to limit this aspect by studying every clinical note of each patient and scoring the complications using the Clavien-Dindo classification. This classification is especially useful to score all minor complications in order to not forget the impact of them on the patient, the health care system and the costs. Another aspect of the retrospective design is overestimation of the duration until wound healing. On one hand the closure of the wounds is not always reported. On the other hand: as the time post-surgery passes by the duration between outpatient clinic visits elongate. Therefore, the time until wound healing reported can be overestimated. The last aspect of the retrospective design in this thesis is that only data post-reconstruction can be reported. For example, the range of motion of the hips would thrive when compared with data of the situation before reconstruction.

This thesis was designed to study the complications, QoL, sexual function and esthetics following vulvoperineal reconstruction with the LPF technique. We found that about two-thirds of the patients experienced complications of some sort, but most complications are minor. Complication rates following LPF reconstruction are still lower compared to following VRAM reconstruction and therefore to us the LPF remains the preferred method of reconstruction. The LPF is also feasible to reconstruct defects in the perineal area. QoL following reconstruction with the LPF is comparable to patients without reconstruction. Sexual activity is lowered and the functioning is worse, though not hampering the satisfaction with the sexual function. Patients seem to be moderately satisfied with the esthetic result following reconstruction. Overall, reconstruction of vulvoperineal defects with the LPF technique is feasible and leads to an acceptable complication rate considering the extent of the defects, a fairly good QoL and patients seem to be content with the moderate sexual function and aesthetic result. The possibility of closure of extensive defects in the vulvoperineal area with the LPF technique creates the option of resection of extensive tumors in this area without disturbing the QoL, sexual function and esthetics in an indispensable way. This thesis highlighted the postoperative outcomes of patients following reconstruction with the LPF technique. Despite the retrospective nature of the studies, the outcomes are still important to consider during patient counseling. Most patients clearly have a need for information prior to an extensive surgery. It is important to set

the expectations of the outcomes following reconstruction realistically during the preoperative consultation. To be able to set those expectations realistic the results of our studies are important in the consultation room.

FUTURE PERSPECTIVES

This thesis can be used as the basis of a large prospective study, ideally performed with the same multidisciplinary team approach as the retrospective studies in this thesis are performed. The study should have standardized measuring points, starting pre-operatively. In order to increase the number of patients, this study should preferably be a multicenter study. However, it is important to realize that the reconstruction technique should be performed exactly in the same way in all centers in order to objectively study the outcomes of all centers as one group. In our studies, the majority of the reconstruction procedures are performed by two plastic surgeons. Standardized measuring points and follow-up creates the possibility to precisely study the time to wound healing and the change in range of motion which was hard to measure with one post-reconstruction measuring point. Wound healing will still be hard to measure based only on follow-up measuring points. A daily diary report from the patients would be more accurate. However, it is questionable if the burden for the patient to keep the diary will outweigh the results of the diary study. Also, pre-operative measuring with the questionnaires would be possible. QoL should, of course, be measured with the EORTC questionnaires, but adding the SF-36 questionnaire should also be considered. This questionnaire also takes the mental health and QoL into account.²² In addition, the Hospital Anxiety and Depression Scale (HADS) should be considered to be part of future studies.^{23,24} Emotional distress is common in patients with oncological diseases and the HADS is a short validated questionnaire that is helpful to show the baseline state and change during treatment. The HADS is also proven to be accurate in cancer patients.²⁵ The FSFI and MFSI questionnaire could be applied to study the sexual function, but preferably combined as one questionnaire to be able to use one set of questionnaires for both genders. To study the esthetic result another questionnaire should be considered, however, no questionnaire for large reconstructions in the vulvoperineal area seems to exist. Therefore, the development of a questionnaire which is able to study the esthetic result of extensive reconstruction in an area which is not usually visible, like the vulvoperineal area, should be part of the future design of the study. Something to consider is to find a uniform manner to measure the defect size. In our study we could only distinguish between the application or a unilateral of bilateral LPF. However, measuring the resection specimen could probably create more accurate results, which could be considered a factor that influences the complications and outcomes of QoL, sexual function and esthetic result. The resection specimen can be measured by the pathologist before preparation

for microscopy takes place and also measurement of the skin defect and depth of the defect during surgery can be performed. Both measurements can be combined to create a more accurate idea of the size of the defect which needs to be reconstructed. Another idea could be to study the application of a biological mesh combined with the LPF. Or one could study the effects of bed rest and the influence of an air fluidized bed on the complication rate. Early mobilization and shorter application of an air fluidized bed might not increase wound complication rates. The multidisciplinary team approach brings different ideas and a wide knowledge together. The collaboration performed in the operating room can be extended to research projects, of which this thesis proves.

CONCLUSION

This thesis provides a first insight into the complications, QoL, sexual function and esthetics following vulvoperineal reconstruction with the LPF technique. With the knowledge gained by this thesis we are able to set realistic patient expectations in the consultation room. Future research in a prospective manner can help to further elucidate aspects along the course of reconstruction that could not be disclosed by this study.

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CHAPTER 9

Nederlandse samenvatting

NEDERLANDSE SAMENVATTING

Het doel van dit proefschrift is om de toepassingen en uitkomsten van reconstructie van het vulvoperineale gebied met de lotus petal flap (LPF) te bestuderen. Bij het bestuderen van de uitkomsten ligt de focus op complicaties, kwaliteit van leven, seksueel functioneren en de esthetische uitkomst. Het proefschrift is onderverdeeld in twee delen. **Deel I** bestudeert vulvoperineale reconstructies met de LPF techniek en **deel II** specifiek de perineale reconstructies.

Hoofdstuk 1 is een inleiding op het proefschrift. In het vulvoperineale gebied kunnen kwaadaardige tumoren voorkomen. Het gaat daarbij meestal om de vulva, het rectum en de anus. Voor uitgebreide tumoren is er meestal uitgebreide operatieve verwijdering nodig. Aanvullend wordt er vaak behandeld met chemoen/of radiotherapie. Bij de operatieve verwijdering van een uitgebreide tumor in het vulvoperineale gebied is er tekort aan weefsel om de wond te kunnen sluiten. Primaire sluiting van het defect is dan niet mogelijk omdat er teveel spanning op de wond ontstaat. Bij te veel spanning op de wond is er een grote kans op wondproblemen zoals dehiscentie, infectie of vertraagde wondgenezing. De beste optie voor het sluiten van deze uitgebreide defecten is reconstructie met een lap. Reconstructie met een lap zorgt voor bedekking van het huiddefect maar kan ook de dode ruimte opvullen met goed doorbloed en niet bestraald weefsel. De LPF is een reconstructie met een lap gebaseerd op kleine bloedvaatjes (perforatoren) in het vulvoperineale gebied. De LPF is zo genoemd omdat de verschillende mogelijkheden van de lap samen lijken op de bloembladeren van de lotusbloem. De meeste onderzoeken naar de uitkomsten van reconstructie met de LPF betreffen kleine studies en zijn met name gefocust op de complicaties. Er is nog geen eerder onderzoek gedaan naar de kwaliteit van leven, het seksueel functioneren en de esthetische uitkomsten na reconstructie met de LPF. Het doel van dit proefschrift is om meer inzicht te geven in de complicaties, kwaliteit van leven, het seksueel functioneren en de esthetische uitkomsten na reconstructie van vulvoperineale defecten met de LPF techniek.

DEEL I

In **deel I** van het proefschrift wordt de vulvoperineale reconstructie bestudeert en het is opgesplitst in drie hoofdstukken. **Hoofdstuk 2** is een beoordeling van de in de literatuur beschreven complicaties die optreden na reconstructie met de LPF. Deze worden vergeleken met de complicaties die optreden na reconstructie met de verticale rectus abdominis myocutane (VRAM) lap. De VRAM lap is een reconstructie techniek waarbij gebruik wordt gemaakt van de rechte buikspier (de musculus rectus abdominis). Uit deze studie bleek dat er veel meer literatuur beschikbaar is over de complicaties die optreden na reconstructie met een

VRAM lap dan met een LPF. De meeste beschikbare studies zijn kleine studies, maar desondanks van redelijke kwaliteit. In het algemeen lieten de studies na reconstructie met de LPF lagere percentages complicaties zien in vergelijking tot de studies na reconstructie met de VRAM lap. Beide reconstructietechnieken zijn toepasbaar bij vulvoperineale defecten. Aangezien de percentages complicaties lager zijn na reconstructie met de LPF, heeft deze techniek de voorkeur bij vulvoperineale reconstructie.

Zoals is gebleken uit hoofdstuk 2 zijn er met name kleine studies verricht naar de resultaten en complicaties na reconstructie met de LPF. Het overgrote deel van deze studies heeft minder dan tien patiënten geïncludeerd. **Hoofdstuk 3** is een retrospectieve studie waar is gekeken naar de complicaties die optreden na reconstructie met de LPF in een groep van 93 patiënten. Hieruit bleek dat bijna 70% van de patiënten postoperatief een complicatie had. De complicaties werden in deze studie geclassificeerd met de Clavien-Dindo classificatie. De Clavien-Dindo classificatie is een classificatie die veel gebruikt wordt in de chirurgie voor het weergeven van complicaties. Het geeft met name de impact weer die de complicatie op de patiënt heeft. De meeste complicaties waren kleine complicaties (51.7%) waarbij er geen behandeling (graad I) nodig was, of behandeling met enkel medicatie (graad II). Daarbij werd geen verschil gezien tussen percentages complicaties van reconstructie van het vulvaire gebied en reconstructie van het perineale gebied.

Hoofdstuk 4 kijkt naar de reconstructie van het vulvaire gebied met de LPF. Hierbij is een vragenlijst onderzoek gedaan en gekeken naar de kwaliteit van leven en het seksueel functioneren na reconstructie met de LPF. De kwaliteit van leven van de patiënten die een reconstructie met de LPF hebben ondergaan is vergeleken met gegevens die bekend zijn over de kwaliteit van leven van gezonde vrouwen. Hieruit bleek dat de kwaliteit van leven na reconstructie lager is dan de kwaliteit van leven van gezonde vrouwen. Echter, wanneer de kwaliteit van leven van patiënten na reconstructie wordt vergeleken met de kwaliteit van leven van patiënten na operatieve behandeling in het vulvaire gebied zonder dat daarbij een reconstructie nodig was dan is deze kwaliteit van leven vergelijkbaar. Het seksueel functioneren van patiënten na reconstructie met de LPF is verminderd ten opzichte van het seksueel functioneren van gezonde vrouwen waarbij dit met name op het aspect pijn lijkt te berusten. Opmerkelijk hierbij is dat patiënten na reconstructie met een LPF aangeven wel tevreden te zijn met hun seksueel functioneren.

DEEL II

In **deel II** wordt gekeken naar de toepassing van de LPF in het perineale gebied en naar de uitkomsten van reconstructie in het perineale gebied met de LPF.

Hoofdstuk 5 beschrijft de ervaringen met de toepassing van de LPF voor reconstructie van het perineale gebied. Deze studie liet zien dat de LPF toepasbaar is voor het sluiten van defecten in het perineale gebied. Er zijn weinig nadelen wat betreft de vorm en functie van het gebied. De complicaties werden geclassificeerd volgens het Clavien-Dindo classificatie systeem. Het aantal complicaties dat optrad was hoog (78.6%). Echter de meeste (72.7%) complicaties waren kleine complicaties. Aangezien het uitgebreide reconstructieve procedures betreft in een gebied dat meestal bestraald is, werd het percentage complicaties beoordeeld als passend. Ook de mediane tijd tot wondgenezing (14 weken) was passend bij de uitbreidbaarheid van de reconstructie.

Hoofdstuk 6 bestudeert de kwaliteit van leven en het seksueel en fysieke functioneren na reconstructie van het perineale gebied met de LPF. De kwaliteit van leven werd vergeleken met beschikbare gegevens van een groep patiënten met een tumor in het perineale gebied waarna er na operatieve verwijdering geen reconstructie nodig was. Hieruit bleek dat er geen verschil in kwaliteit van leven was bij patiënten met operatieve verwijdering van een perineale tumor waarbij geen reconstructie nodig was en bij patiënten waarbij er wel reconstructie met een LPF plaatsvond. Ondanks de uitgebreidere tumor en verwijdering van een uitgebreidere tumor en daarnaast een reconstructie met de LPF heeft deze groep dus geen slechtere kwaliteit van leven dan patiënten die geen reconstructie hebben ondergaan. De seksuele activiteit na reconstructie met de LPF was echter fors verlaagd ten opzichte van voor de reconstructie. Vóór de reconstructie waren de meeste patiënten seksueel actief, terwijl na de reconstructie nog slechts één derde van de patiënten seksueel actief was. Ook het fysieke functioneren verslechterde na de reconstructie. Er waren echter grote verschillen te zien tussen de verschillende patiënten. Ook op dit vlak waren de patiënten wel tevreden ondanks het verminderde seksuele en fysieke functioneren.

Tot slot beschrijft **hoofdstuk 7** de eerste studie naar de esthetische uitkomsten na reconstructie van het perineale gebied met de LPF. De esthetische uitkomst is een onderbelicht onderwerp waardoor het bestuderen van deze uitkomst ook lastig bleek. Er zijn geen goed passende vragenlijsten voor esthetische uitkomsten in specifiek het perineale gebied en een uitgebreide reconstructie. Deze studie laat de resultaten zien van de beoordeling van de esthetische uitkomsten door zowel patiënten, leken en plastisch chirurgen. De patiënten waren redelijk tevreden met de esthetische resultaten en de beoordeling van de patiënten was niet significant verschillend van de beoordeling door de leken en plastisch chirurgen.

In **hoofdstuk 8** worden de voorgaande hoofdstukken samengevat, de verschillende aspecten bediscussieerd en toekomstige mogelijkheden besproken. In de toekomst kan een grote prospectieve studie de reeds onderzochte aspecten verder uitbouwen, bij voorkeur met dezelfde multidisciplinaire aanpak als in dit proef-

schrift is verricht. Daarbij is een gestandaardiseerde aanpak van het verkrijgen van de uitkomsten en follow-up van groot belang.

CONCLUSIE

Concluderend geeft dit proefschrift inzicht in de complicaties, de kwaliteit van leven, het seksueel functioneren en de esthetische uitkomsten na reconstructie in het vulvoperineale gebied met de lotus petal flap. Met deze kennis kan de patiënt beter geïnformeerd worden voorafgaand aan de operatie. Toekomstig onderzoek met een prospectief karakter kan hierop voortbouwen.

CHAPTER 10

Appendices

About the author

List of publications

List of presentations

Dankwoord

ABOUT THE AUTHOR

Joke Oosta-Hellinga was born on September 22nd 1989 in Leeuwarden, the Netherlands. She is the daughter of Pyt Hellinga and Hiske Galema and grew up on a farm located along the Boarn River in Grou with her younger siblings Wopke, Clara and Anneke. After graduating from Christelijk Gymnasium Beyers Naudé in Leeuwarden in 2007, she left the Netherlands and lived in Cambridge, Minnesota (United States of America) for one year. She attended the Cambridge-Isanti High School in Minnesota for a senior year. It was there, during her medical biology classes, that she decided to study Medicine.

Back in the Netherlands, she started her study Medicine at the University of Groningen in 2008 and graduated six years later in 2014. During her last year she wrote her master thesis on the complications following reconstruction using the lotus petal flap at the department of Plastic Surgery of the University Medical Center Groningen (UMCG) under supervision of drs. Y. Eltahir and drs. P.C.K.H. Khoe. The master thesis was the first step of this dissertation.

After graduation she continued her research under supervision of prof. dr. P.M.N. Werker, dr. M.W. Stenekes and dr. B. van Etten. In March 2015 she started working at the department of Surgery of the Martini Hospital in Groningen under supervision of dr. W. Kelder. Fourteen months later, in May 2016, she started working at the department of Plastic Surgery of the UMCG and was accepted to the Plastic Surgery training program in August 2016. During and after this time she continued her research on reconstruction using the lotus petal flap.

Joke started her Plastic Surgery residency with her General Surgery training at the Martini Hospital in Groningen under supervision of dr. W. Kelder in December 2017. In February 2020 she started her Plastic Surgery training at the UMCG under supervision of prof. dr. P.M.N. Werker. The Plastic Surgery training was continued in October 2020 at the Medical Center Leeuwarden under supervision of dr. C.M. Mouës-Vink. In 2021 she presented her dissertation titled 'Reconstruction using the lotus petal flap: applications and outcomes' to obtain her doctoral degree. Shortly after defending her dissertation on August 30th 2021, she will continue her Plastic Surgery training at the department of Plastic Surgery of the UMCG.

Joke is married to Gerlof Oosta in 2011 and they live together with their children Pieter (2017) and Leonie (2019) in Groningen.

LIST OF PUBLICATIONS

1. Janse IC*, **Hellinga J***, Blok JL, van den Heuvel ER, Spoo JR, Jonkman MF, Terra JB, Horváth B. Skin-tissue-sparing excision with electrosurgical peeling: a case series in hidradenitis suppurativa. *Acta Derm Venereol.* 2016;96(3):390-391.
2. **Hellinga J***, Khoe PCKH*, van Etten B, Hemmer PHJ, Havenga K, Stenekes MW, Eltahir Y. Fasciocutaneous lotus petal flap for perineal wound reconstruction after extralevator abdominoperineal excision: application for reconstruction of the pelvic floor and creation of a neovagina. *Ann Surg Oncol.* 2016;23(12):4073-4079.
3. **Hellinga J**, Khoe PCKH, Stenekes MW, Eltahir Y. Complications after vulvar and perineal reconstruction with a lotus petal flap. *Ann Plast Surg.* 2018;80(3):268-271.
4. **Hellinga J***, te Grootenhuis NC*, Werker PMN, de Bock GH, van der Zee AGJ, Oonk MHM, Stenekes MW. Quality of life and sexual functioning after vulvar reconstruction with the lotus petal flap. *Int J Gynecol Cancer.* 2018;28(9):1728-1736.
5. Blok RD, Hagemans JAW, Klaver CEL, **Hellinga J**, van Etten B, Burger JWA, Verhoef C, Hompes R, Bemelman WA, Tanis PJ. A systematic review and meta-analysis on omentoplasty for the management of abdominoperineal defects in patients treated for cancer. *Ann Surg.* 2020;271(4):654-662.
6. **Hellinga J**, Stenekes MW, Werker PMN, Janse M, Fleeer J, van Etten B. Quality of life, sexual functioning, and physical functioning following perineal reconstruction with the lotus petal flap. *Ann Surg Oncol.* 2020;27(13):5279-5285.
7. **Hellinga J**, Rots M, Werker PMN, Stenekes MW. Lotus petal flap and vertical rectus abdominis myocutaneous flap in vulvoperineal reconstruction: a systematic review of differences in complications. *J Plast Surg Hand Surg.* 2021;55(2):67-82.
8. **Hellinga J**, Fleeer J, van der Lei B, Werker PMN, van Etten B, Stenekes MW. Esthetic outcomes of perineal reconstruction with the lotus petal flap. *Plast Reconstr Surg Glob Open.* 2021;9(6):e3621.

* these authors contributed equally

LIST OF PRESENTATIONS

1. **Hellinga J**, Khoe PCKH, Stenekes MW, Eltahir Y. Reconstruction of vulvar and perineal defects by the lotus petal flap: a retrospective analysis of the results. Oral presentation. Scientific meeting of the Netherlands Society for Plastic Surgery, Amsterdam, The Netherlands, October 2015.
2. **Hellinga J**, Khoe PCKH, van Etten B, Hemmer PHJ, Havenga K, Stenekes MW, Eltahir Y. Application of the fasciocutaneous lotus petal flap for reconstruction of the pelvic floor after extralevator abdominoperineal excision. Poster presentation. Symposium Experimental Research Surgical Specialisations, Leiden, The Netherlands, December 2015.
3. **Hellinga J**, te Grootenhuis NC, Werker PMN, van der Zee AGJ, Oonk MHM, Stenekes MW. Sexual functioning and quality of life following lotus petal flap reconstruction. Oral presentation. Scientific meeting of the Netherlands Society for Plastic Surgery, Amsterdam, The Netherlands, May 2017.
4. **Hellinga J**, Khoe PCKH, Stenekes MW, Eltahir Y, Werker PMN. Lotus petal flap reconstruction: complications following vulvar and perineal reconstruction. Oral presentation. 28th Scientific meeting of the European Association of Plastic Surgeons, Pisa, Italy, May 2017.
5. **Hellinga J**, Stenekes MW, Janse M, Fleeer J, van Etten B, Werker PMN. Lotus petal flap reconstruction: quality of life and sexual functioning following perineal reconstruction. Oral presentation. 31st Scientific (virtual) meeting of the European Association of Plastic Surgeons, Athens, Greece, May 2021.

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