Tidsskriftet Tidsskrift for Den norske legeforening

Reconstruction of wound defects in the perineum

CLINICAL REVIEW

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Surgical procedures in the perineum can cause major soft-tissue defects that require reconstruction with plastic surgery. In this article we present plastic surgery principles for the reconstruction of wound defects and common methods used to reconstruct wound defects in the perineum.

A need for reconstruction of defects in the perineum tends to arise as a result of surgery for gastrointestinal or gynaecological cancer. Techniques for reconstructing perineal defects range from simple methods, such as direct closure of wounds and local skin flaps, to more complex procedures such as pedicled or free flaps consisting of skin and/or muscle (1, 2). Reconstruction after major tumour resections in the pelvis and perineum reduces the risk of wound complications (3) and makes it possible to cover large wound defects. This can increase the opportunity for achieving free margins in surgery of large tumours in the skin and mucous membranes (4). A key principle in reconstructive surgery is to use the least complex reconstruction that gives a functional and aesthetically acceptable result for the patient. This is known as *the reconstructive ladder* (5).

In this clinical review article, we present general plastic surgery principles for reconstruction of wound defects and give an account of pre-operative assessments of wound defects in the perineum and the most common methods of reconstruction. The manuscript is based on a discretionary review of the literature and our own clinical experiences.

Skin grafts and local flaps

A skin graft is harvested from a donor site and placed on a recipient site that needs skin coverage. In principle, skin can be harvested from anywhere on the body. A suitable donor site is determined by the conditions in the recipient site, such as anatomical position and the size of the area that needs to be covered, but also the morbidity of the donor site. The skin graft is dependent on the ingrowth of blood vessels from the recipient site and is therefore not suitable for covering a poorly circulated wound base, such as a previously irradiated area. A skin graft is thin and not suited for wound defects where there is loss of soft tissue as well as skin, and where it is desirable to reconstruct a volume defect. Skin grafts are not widely used for reconstructions in the perineum.

In contrast to a skin graft, a skin flap is moved from a donor site to a recipient site with its blood supply intact. It can therefore be used to cover a wound base which is not well circulated. A flap consisting of skin and the underlying subcutaneous fatty tissue can be made significantly thicker than a skin graft and is well suited for reconstruction of minor volume defects. Flaps can be categorised according to their place of origin relative to the wound defect, the kind of tissue they consist of, and their blood supply. A local skin flap consists of skin and subcutaneous fatty tissue in close relation to the defect and receives its blood supply either through unbroken skin or subcutaneous tissue. Local flaps can be classified according to the method used to move the skin flap into the wound defect (Figure 1). Local flaps are widely used for reconstructions in the perineum.

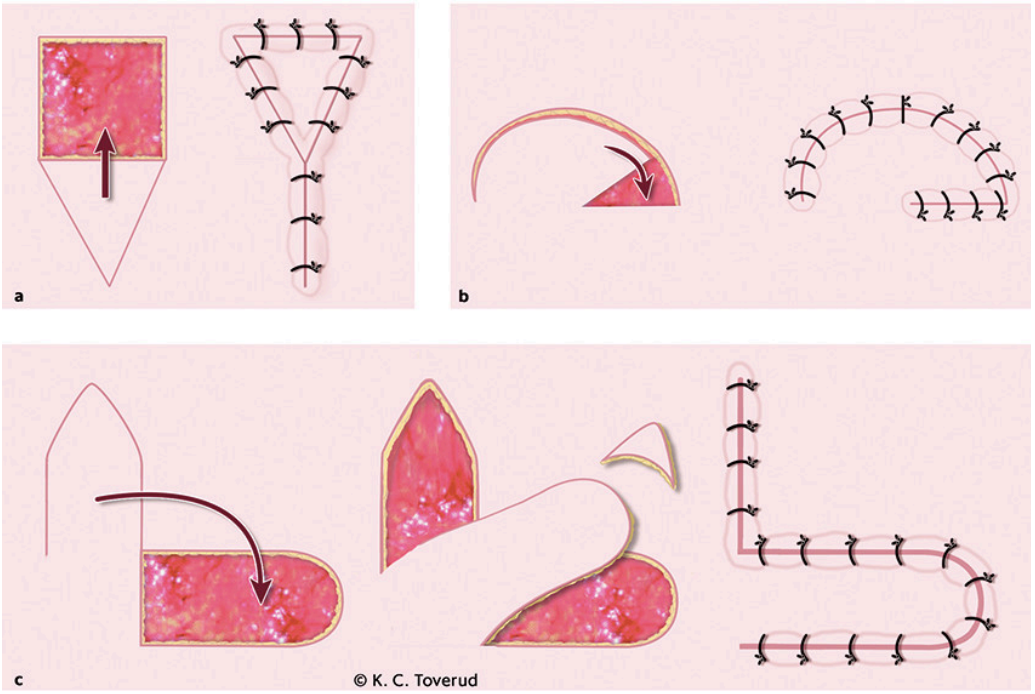

Figure 1 Examples of local skin flaps that can be used for reconstruction of wound defects. The figure shows the wound defect to be covered in red, the incision in the skin and the result after transfer of the flap and closure of the wound defect for an advancement flap (a), a rotation flap (b) and a transposition flap (c).

Pedicled and free flaps

When larger tissue volumes need to be reconstructed, a pedicled flap from a site not immediately adjacent to the wound defect can be used, or alternatively a free flap. A *pedicled flap* is supplied with blood from one or more defined vessels. The vascular pedicle of the flap in question is preserved, and the flap, which consists of skin, subcutaneous fat and/or muscle, is dissected out of its surrounding tissue and moved into the wound defect. In a *free flap*, on the other hand, the vascular pedicle of the tissue to be used for reconstruction is severed and connected by anastomosis to vessels on the recipient site using microsurgery techniques. Pedicled flaps are widely used for reconstruction of combined defects in the pelvis and perineum.

Preoperative assessment

In the perineum, there can be a need for both skin coverage and reconstruction of a major volume defect. The objective of the reconstruction of wound defects in the perineum is to add well vascularised tissue, fill the volume defect and close the defect without tension to prevent wound complications, and to achieve an anatomically and functionally good result with an acceptable morbidity in the donor site (6).

The choice of a reconstruction method must take into account the expected wound defect, the patient's comorbidity, risk of wound complications, existing scars, hernia or stomas, morbidity in the donor site and the functional and aesthetical result. In large procedures in the perineum or pelvis it is important to identify which structures will be involved. Factors that could affect the patient's ability to heal, especially smoking, diabetes or immune suppression, should be identified. Previous radiotherapy in the wound area is associated with suboptimal wound healing and increased risk of complications (7).

In reconstruction of wound defects where the tumour has been irradiated, it is generally desirable to reconstruct the tissue defect with non-irradiated tissue. It is therefore important to establish an overview of previous surgical interventions and radiotherapy both in the wound defect and the adjacent areas. Some reconstruction methods may entail a risk of reduced functionality or scarring in cosmetically challenging sites. Often, multiple reconstruction alternatives will be available. The advantages and disadvantages of the different alternatives for reconstruction should therefore be discussed with the patient before a method is chosen. The choice of reconstruction also depends on the experience and preferences of the operating surgeon and the treatment institution.

Interdisciplinary approach

It is essential to clarify the scope of the defect that needs reconstruction. This includes both the kind of tissue to be reconstructed (skin, subcutis and/or mucous membrane) and the structures that need reconstruction. Alternative reconstruction methods should be considered in case the wound defect turns out to be more comprehensive than expected. The surgeons responsible for the oncological part of the operation should have an understanding of which anatomical structures should be taken into account, for example the blood supply to tissue that will be used in the reconstruction. A shared understanding of both the oncological and the reconstructive part of the intervention is of major importance for the final outcome.

Reconstruction of simple defects

In minor soft-tissue defects in the perineum, direct closure or local skin flaps can be a good alternative. One example is an advancement flap, where the tissue is moved by making a V-shaped incision through the skin and fatty tissue adjacent to the defect. The skin flap can then be moved into the defect (8, 9). After closure, the scar looks like a Y, and this advancement flap is therefore referred to as a V-to-Y flap (Figure 1 a). Larger wound defects can be closed using two advancement flaps, one from each side of the defect (Figure 2).

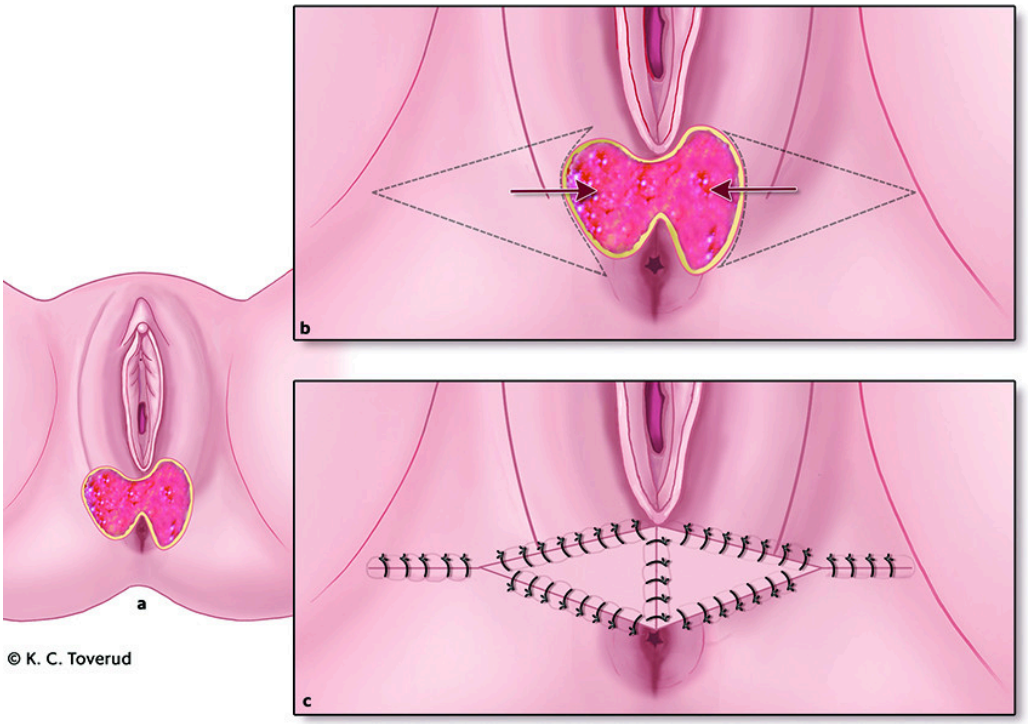

Figure 2 Illustration of how a wound defect in the perineum can be covered with bilateral advancement flaps. The wound defect is marked in red.

Reconstruction of complex defects

Complex wound defects in the perineum are defined as wounds with a large volume loss in the pelvis, or where there is a need for a partial or total reconstruction of the vagina (6). In larger skin and vaginal defects without any large volume defect in the pelvis, local skin flaps consisting of skin and subcutaneous tissue from the pudendal and gluteal regions will be good alternatives for reconstruction. With a suitable wound defect and well-planned incisions, the scars can be concealed in the gluteal fold (10–12). If the patient has a limited volume defect that needs reconstruction with non-irradiated tissue, a flap of the gracilis muscle can be a good alternative (13, 14). Via a skin incision in the thigh, this muscle can be dissected from where it is attached by the medial tibial condyle and moved under the skin into the wound cavity. If a skin defect also needs to be covered in the same intervention, the muscle can be harvested with the overlying skin.

Cancer surgery in the pelvis can be associated with large volume defects. Depending on the underlying cancer, it could be relevant to remove not only skin in the perineum, but also the anus, rectum and/or urinary bladder, the uterus, ovaries and parts or all of the vagina. The patients have often received pre-operative radiotherapy in the area to be reconstructed. There could be a need to fill volume defects in the pelvis, restore skin coverage in the perineum and reconstruct the vagina partly or in full with non-irradiated tissue.

A frequently used method for reconstructing this type of defect is a pedicled flap made from one of the muscle bellies of the rectus abdominis muscle, with or without the overlying skin (vertical rectus abdominis myocutaneous flap,

VRAM flap). The muscle can cover a large volume defect in the pelvis, and the skin island can be used both in the reconstruction of a skin defect in the perineum and for partial or full reconstruction of the vagina (15). Circulation of the flap is dependent on the inferior epigastric artery not being damaged from previous procedures and the patient not having previously undergone surgery in which the rectus abdominis muscle has been severed, for example open biliary tract surgery or open liver surgery. The flap is harvested by drawing up a skin island corresponding to the perineal and vaginal defect over the cranial part of the muscle. The skin is incised down to the muscle, while the blood vessels to the skin from the underlying muscle are preserved. The muscle is severed cranially where it is attached to the costal arch and brought down into the pelvis. The skin island is drawn through the perineum and used to reconstruct the perineum and the posterior vaginal wall or to construct a neo-vagina (16) (Figure 3).

Figure 3 Wound defect after resection of the rectum and anus which has been reconstructed with a vertical rectus abdominis myocutaneous flap (VRAM flap). a) The rectus abdominis muscle with an adjoining skin island is dissected free. The size of the skin island is adapted to the skin defect in the perineum. The muscle that has been dissected and the adjoining skin island are supplied with blood from the inferior epigastric artery. b) The muscle is moved into the small pelvis, the skin island is withdrawn through the defect in the perineum. c) The muscle fills the volume defect in the pelvis, the skin island with the underlying muscle is used to reconstruct the defect in the perineum. The wound defect in the abdomen is then covered. The figure has been modified from Butler et al. (15).

After reconstruction of the perineum, it is important to avoid pressure on the reconstructed area. Since there is always reduced blood supply to the tissue that has been moved, external pressure on the tissue will cause the blood supply to diminish. On the first days following surgery an individual

assessment must be made of how much activity the patient can engage in and how much pressure can be applied to the flap. Optimalisation of the patient's nutrition is also important to ensure the best possible healing process (17).

The most common complications after reconstruction of the perineum are local wound infections and poor circulation in parts of the flap. Approximately one-quarter of the patients sustain a minor complication, which as a rule is addressed during the hospitalisation period. A total flap loss rarely occurs (18). A hernia after harvesting of the rectus muscle is not totally uncommon and can happen after discharge. The patients will often have reduced sensitivity in the reconstructed area as a result of nerves having been severed during the intervention. If the flap is too voluminous, the size of the flap could be reduced after the wound has healed.

In the five-year period 2016–20, the Section for Oncologic Plastic Surgery at Radiumhospitalet conducted 266 perineal reconstructions, whereof 168 (63 %) were reconstructions with a VRAM flap. Most of these reconstructions were undertaken after an abdominoperineal resection, where the anus and rectum were removed. As a rule, the patients underwent open surgery with an abdominal midline incision, enabling the VRAM flap to be harvested through an extension of the incision that was used for the oncological part of the surgery. As the proportion of abdominoperineal resections undertaken with minimally invasive techniques grows (19), reconstructive methods will be called for that enable a satisfactory reconstruction without the need for a midline incision in the patient (20).

Summary

Major gastrointestinal and gynaecological cancer surgery in the pelvis and perineum can cause soft-tissue defects that require reconstruction with plastic surgery techniques. As a rule, several alternatives are available for reconstruction of the perineum. An interdisciplinary approach with a shared understanding of what needs to be removed and what tissue can be used for reconstruction is important.

The article has been peer reviewed.

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Publisert: 25 October 2021. Tidsskr Nor Legeforen. DOI: 10.4045/tidsskr.21.0161
Received 27.2.2021, first revision submitted 12.6.2021, accepted 27.8.2021.