Journal of Plastic, Reconstructive & Aesthetic Surgery (2012) 65, 1377—1383

JPRAS
An International Journal of Surgical Reconstruction
www.JPRASurg.com

Refinements in reconstruction of penile skin loss using intra-operative prostaglandin injections, postoperative tadalafil application and negative pressure dressings

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Received 1 December 2011; accepted 14 April 2012

KEYWORDS
Skin graft;
Penile reconstruction;
Negative-pressure wound therapy;
Tadalafil;
PDE5-inhibitor;
Prostaglandin

Summary *Purpose:* Penile shaft skin defects represent demanding reconstructive tasks because a high degree of flexibility and stability of the skin grafts are essential to allow regular erections and sexual intercourse.
Methods: A new concept of tailoring skin grafts to the erect penis by intra-operative application of prostaglandin E1 and postoperative stabilisation by negative-pressure wound therapy and pharmacological expansion by tadalafil was tested on four patients with penile shaft skin defects. Graft take, stability, pliability, softness and aesthetic results were evaluated up to at least 12 months postoperatively. The ratio of the skin transplanted area in the non-erect compared to the erect penis (non-erect/erect ratio) and the ratio of the skin transplanted area in the erect penis at 12 months compared to intra-operatively (Post/Pre ratio) was determined to define the amount of graft contraction and flexibility. International Index of Erectile Function (IIEF)-5 scores were evaluated postoperatively.
Results: There were no complications. Graft take was 97, 100, 100 and 100%. Stable skin grafts were achieved after 2 weeks. Sexual intercourse was possible at 2—3 months. The Post/Pre ratio was between 81 and 87% and proves comparably mild contracture rates. The non-erect/erect ratio of 50—72% shows how significantly undersized penile shaft skin grafts are when adjusted to the non-erect penis and that an adequate flexibility for erections can be reconstructed. IIEF-5 scores proved regular potency in three patients; one patient was no longer sexually active.

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doi:10.1016/j.bjps.2012.04.020

Conclusions: With the new concept of tailoring the skin graft to the erect penis, pharmacological expansion and external stabilisation by vacuum-assisted closure (VAC) dressing the difficult task of penile skin reconstruction can be facilitated, accelerated and the functional and aesthetic outcome improved compared to earlier efforts or to results presented in the literature.

Defects of the penile skin are generally addressed by skin grafts. This is technically demanding due to the deformable and soft wound bed, the convex contour and the existent shear forces between the genitalia and thighs during mobilisation. The needed expandability for erections and stability for sexual intercourse add to the high requirements. Although the application of negative pressure dressings (VAC) has helped to increase take rate of skin grafts,[1] prolonged postoperative courses and re-operations due to partial graft loss are still common.[2–4] The fact that the skin graft is adapted to the non-erect penis intraoperatively leads to a deficit of tissue in the erect penis.[5] If the graft is applied to the erect penis, a prolonged erection until complete skin graft take will lead to erectile dysfunction.[6] Therefore, a compromise between penile expansion and adequate blood flow has to be found. This can be achieved by applying alprostadil intra-operatively and a phosphodiesterase 5 (PDE5) inhibitor postoperatively. Tadalafil leads to a relaxation of the smooth muscle fibres in the cavernous body similar to the popular sildenafil (Viagra©) but has a longer half-time of about 18 h[7] Several studies show the beneficial effect of PDE5 inhibitors on skin flap survival and neo-vascularisation.[8–12]

Suboptimal postoperative results are further aggravated by a postoperative trend towards wound-bed contraction after the skin transplantation. There are no reports of penile shaft skin reconstruction that provide comparable measurements of wound-bed contraction after skin transplantation but experimental data from animal models report wound-contracture rates after split-thickness skin grafting to 62%, 34% and 27% of the original size, respectively[13–15] and clinical settings with contracture rates after full-thickness transplants in head and neck reconstruction to 62% of the original size.[16] Increasing thickness of dermis in a split-thickness skin graft reduces the secondary contraction rates,[17,18] a condition that must be of utmost concern in an organ whose physiological function is dependent on frequent expansion. Meshed skin grafts should be avoided because the areas between the mesh lack dermal support and the pattern stays visible.[17,19] Full-thickness skin grafts have the disadvantage of containing hair follicles and are difficult to obtain in larger sizes.[4]

Material and methods

A new concept for reconstructive skin grafting of the penis relying on both an external splinting by VAC and pharmacological 'internal' expansion by applying prostaglandin E1 intra-operatively and PDE5 inhibitor postoperatively was tested prospectively on four patients. Patient details can be viewed in Table 1. All patients were potent before surgery, but patient 3's sexual life was hindered by the buried appearance of the penis and patient #2 was not sexually active anymore. An exemplary pre-reconstructive clinical finding can be seen in Figures 3 and 5. Results were evaluated after VAC removal on day 5, after 2 weeks, 1, 3 and 12 months. Evaluation of sensitivity was performed by digital tactile stimulation of the transplanted areas in comparison to an adjacent healthy skin area and subjective self-assessment by the patient. After 12 months, the skin-grafted area was measured in the non-erect and the erect penis (non-erect/erect ratio) to assess how much of an 'oversizing' of the transplant is performed during this procedure compared to transplanting the defect in the non-erect penis. At the same time, the size of the transplanted surface in the erect penis was compared to the area of skin-graft transplantation during the operation (Post/Pre ratio) to evaluate the amount of contracture of the transplanted wound bed during the first 12 months. Patients were additionally asked to complete the 5-item International Index of Erectile Function (IIEF) tool. The IIEF has a maximum score of 25 and values below 22 indicate erectile dysfunction.[20]

Operative technique

In general anaesthesia, a Foley catheter was placed to facilitate the placement of the skin graft and to be able to stretch the penis during VAC placement. Ten μg of prostaglandin E1 is injected into the corpora cavernosa, inducing an erection. The skin graft is harvested at a thickness of 0.6 mm from the lateral thigh. Small slit incisions are made by scalpel. In most cases, a new transition between the penile shaft and the adjacent inguinal region has to be defined by several sutures as proximal as possible to reconstruct a maximum penile length. Remaining oedematous parts of the former preputium may form a ring of tissue in a way that has been described as a "doughnut deformity"[2] (compare Figure 5) and should be excised to create a new and natural corona. The skin graft is then sutured distally and to the proximal end of the shaft by a running 5/0 monofilament polylactite suture (Figure 1). Several through and through sutures are placed through the graft into the penile shaft to additionally fix the transplant to the wound bed (Figure 1 arrows). A distally closed tube of KCI WhiteFoam© (KCI, San Antonio, TX, USA) is designed around the penis, while gentle traction is applied to the intraoperatively placed Foley catheter, and fixated by staples, thereby achieving a rigid stabilisation around the still erect and therefore expanded penis. Two foils are applied in