

Reconstruction of the male external genitalia in diverse disease processes: Our reconstructive algorithm, techniques, and experience

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Abstract

Background: Male genital form and function may be rendered abnormal by a number of disease processes, with profound associated psychological and functional consequences. The aim of the study is to review our reconstructive experience with cases of genital loss or distortion due to nonmalignant diseases processes and atypical neoplasia.

Materials and methods: A retrospective review of a prospectively maintained database was performed to identify reconstructive cases performed from 2018 to 2020 under the care of a single surgeon. Male patients 18 years or older with a disease diagnosis other than squamous cell carcinoma affecting genital form were included. Disease processes, patient factors, surgical techniques, and both functional and cosmetic outcomes were reviewed.

Results: Fourteen cases were identified. The patients had a mean age of 52.2 years (range, 21–72 years). Acquired buried penis was present in 8 patients. Etiology of genital abnormality included balanitis xerotica obliterans (n = 6), excess skin loss at circumcision (n = 2), self-injection of petroleum jelly to penile shaft (n = 1), Fournier gangrene (n = 1), hidradenitis suppurativa (n = 1), extramammary Paget disease (n = 1), idiopathic lymphoedema (n = 1), and penoscrotal webbing (n = 1). Reconstructive techniques performed included penile debridement/shaft skin release, scrotoectomy, suprapubic apronectomy, and division of penoscrotal webbing, in combination with split-thickness skin grafting where required. A penile implant was inserted in one patient. Reconstructive planning, techniques, and outcomes are described.

Conclusions: A variety of reconstructive techniques in andrology can be used to improve the aesthetic and functional outcomes of multiple disease processes affecting the male external genitalia.

Keywords: Male genitalia; Genital reconstruction; Genital skin grafts; Buried penis; Penoscrotal web; Suprapubic apronectomy; Balanitis xerotica obliterans; Hidradenitis suppurativa; Genital reconstruction algorithm

1. Introduction

The loss or abnormality of male genital form and function can arise from a variety of etiologies, including congenital conditions, trauma, iatrogenic injury, neoplasia, infection, and inflammatory disorders.^[1] Genital loss or disfigurement may result in debilitating loss of organ function, which often leads to profound psychological and psychosexual consequences. Challenges in male genital reconstruction include the need to address tissue loss, restore organ function, and achieve an acceptable cosmetic outcome given the strong association between male genital subjective appearance and overall body image.^[2,3] Increasing ascent of the reconstructive elevator, with application of split-thickness skin grafting and tissue flaps to address skin loss, has been described in this field in recent times.^[4]

There is a growing body of literature regarding reconstructive genital surgery for patients affected by penile cancer, which is typically squamous cell carcinoma,^[5] and patients incurring genital injuries in the context of military and civilian violent conflict.^[6,7] A diverse array of other disease processes can also deform the male external genitalia. In this report, we describe our approach to patient assessment and surgical planning before male genital reconstruction, developed over time in an Irish center receiving nationwide referrals for andrological conditions. We discuss our experience with surgical techniques used in such a patient population, with diverse case descriptions and illustrated examples.

2. Methods and technique

2.1. Subjects and data collection

After institutional approval, a retrospective review of our reconstructive database was conducted, identifying distinct cases of male genital reconstruction 2018–2020 performed in our center. Adult male patients who had undergone genital reconstruction for non-malignant conditions or atypical neoplasia (ie, nonsquamous cell carcinoma) were included. Outcome measures included feasibility of reconstruction, graft take and wound healing, complications, restoration of normal genital form, and patient satisfaction. Data were collected and reviewed by 2 investigators (first and senior authors). A selection of representative and anonymized clinical photographs was included in this report to illustrate the principles discussed.

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2.2. Surgical technique

2.2.1. Preoperative considerations For elective cases, patients are reviewed in an andrology outpatient clinic, examined and carefully counseled regarding reconstructive options. Patients are then engaged in preoperative optimization and, where relevant, are strongly encouraged to optimize glycemic control, cease smoking, and aim to achieve a healthy body mass index, with support services offered as required. If possible, and upon discussion with the prescribing clinical team, immunosuppressant medications are discontinued preoperatively. Anticoagulant and antiplatelet agents other than acetylsalicylic acid are also temporarily suspended preoperatively.

2.2.2. Surgical planning A personalized reconstructive plan is designed for each patient with various combinations of surgical techniques selected from the reconstructive armamentarium and tailored to an individual patient’s requirements and preferences. Figure 1 presents a decision tree devised to assist in this planning stage. The proposed treatment options and realistic outcome expectations are discussed in detail by the patient and the surgeon.

2.2.3. Preparation and operative technique Although we have performed genital reconstruction under local anesthesia in specific circumstances, general anesthesia is preferred. The patient is placed supine with the legs slightly splayed or in low lithotomy, depending on the planned approach. Broad-spectrum intravenous antibiotics are administered and skin preparation and draping are performed in routine fashion. A surgical marker is used to plan intended skin incisions. During any skin excision, the underlying fascial layers are preserved as much as possible. For small defects of the glans penis in uncircumcised males, we mobilize the outer layer of the prepuce and use it to cover the defect as a flap before completion circumcision. Where a skin graft is required, a split-thickness skin graft (SSG) is generally harvested from the lateral thigh after skin shaving and lubrication, with the use of a powered dermatome set at 12/1000- to 20/1000-inch thickness. Grafts are fenestrated with stab incisions; however, we do not mesh penile shaft grafts in general, as we have found that unmeshed grafts are associated with superior cosmesis and greater elasticity for future sexual function. Grafts are anchored to the surrounding skin and underlying fascia generally with 4–0 undyed absorbable braided suture at their

perimeter, with additional quilting sutures placed. A urethral catheter is placed before dressing application. Where a graft has been used, we have found a modification of the tie-over dressing for graft application described by Malone et al.^[8] to be invaluable. A non-adherent dressing is placed over the graft, followed by sterile gauze, with overlying sheets of polyurethane foam (Lyof foam®) stapled together and sutured to the surrounding skin edges using 4–0 nylon sutures. Skin graft donor sites are covered with alginate-based dressings reinforced with gauze and secured with adhesive tape.

2.2.4. Postoperative care Postoperative care instructions are tailored to each patient based on the extent of the reconstruction. For patients with SSGs, bedrest for a period of 48 hours is prescribed. Broad-spectrum antibiotics are administered intravenously for 48 hours. Chemical thromboprophylaxis is commenced the evening of surgery with subcutaneous low molecular weight heparin. Vitamin C supplements at 1000 mg/d are administered to all patients with skin grafts, and protein/calorie supplements are used in situations of malnourishment or limited intake with dietician input. The donor-site dressing is changed on postoperative day 2. The tie-over dressing for graft application dressing remains in place for 7 days, and a urethral catheter is left in situ for 14 days in patients with a skin graft. Patients are reviewed regularly by clinical nurse specialists and the urology team until healing is deemed complete.

3. Results

Fourteen patients were identified, a mean age of 52.2 years (21–72 years). A summary of patients and reconstructive approaches are presented in Table 1. Patients with adult acquired buried penis syndrome are grouped I–IV as per the classification system by Hesse et al.^[9] Figure 2 illustrates examples of preoperative conditions we have encountered. Figure 3 displays intraoperative techniques used, and Figure 4 contains images of reconstructive outcomes. The supplementary video (<http://links.lww.com/CURRUROL/A23>) outlines some of the key reconstructive steps.

Reconstruction was feasible in accordance with the preoperative plan for all patients. Histological specimens confirmed benign

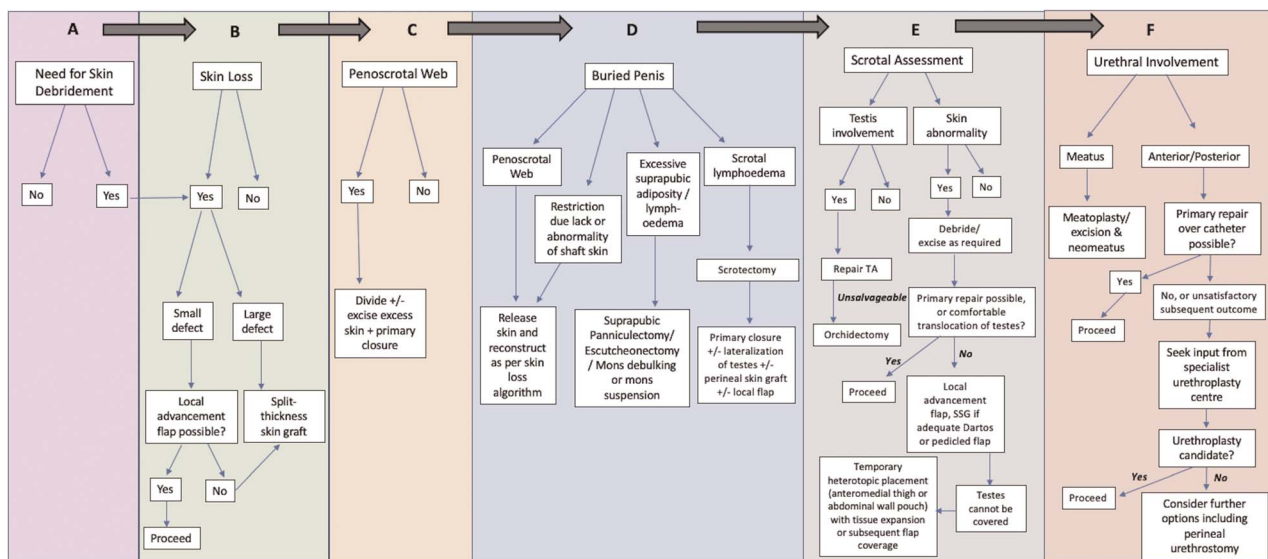


Figure 1. Decision tree used in preoperative planning. SSG = split-thickness skin graft.

Table 1
Patient characteristics and management.

Patient	Age bracket, yr	Comorbidities	Issue	Class*	Etiology	Reconstructive approach	Skin graft variables
Patients with acquired buried penis							
1	30–34	Elevated BMI	Deficiency of penile shaft skin post circumcision with scrotalization of the penile shaft and penoscrotal webbing. Irregular circumcision wound.	Type I	Excess skin excision during circumcision	Revision of circumcision. Degloving and release of penis; reconstruction with SSG to penile shaft. Stretched penile length 5 cm before procedure and 12.5 cm at follow-up. Degloving and release of penis; reconstruction with SSG to penile shaft.	20/1000 inch 7.6 × 9 cm
2	20–24	Nil	Deficiency of penile shaft skin post circumcision with scrotalization of penile shaft and penoscrotal webbing.	Type I	Excess skin excision during circumcision		20/1000 inch
3	40–44	Previous wide local excision of penile SCC	Severe BXO, partial burying of penis. Previous conservative circumcision; remnant prepuce fused to glans. Buried penis + erectile dysfunction.	Type I	BXO	Redo circumcision, partial glansectomy, excision of penoscrotal web, and phallic reconstruction with SSG.	20/1000 inch 5.1 × 9 cm
4	55–59	Elevated BMI	Buried penis with severe BXO.	Type I	Penoscrotal web + obesity BXO	Unburying of penis, division of penoscrotal web/scrotoplasty, and insertion of malleable penile prosthesis.	-
5	60–64	BMI	Buried penis with severe BXO.	Type III	BXO	Apronectomy, unburying of penis, and excision of shaft skin SSG.	16/1000 inch
6	55–59	Obesity Insulin-dependent diabetes mellitus	Buried penis with insufficiency and BXO of penile shaft skin.	Type III	BXO + shaft skin insufficiency + obesity	Suprapubic lipectomy and total phallic reconstruction with SSG.	16/1000 inch 7.6 × 9 cm
7	60–64	Obesity Impaired glucose tolerance Cardiorespiratory disease	Buried penis with BXO and adherence of shaft skin to glans penis after circumcision.	Type III	BXO + penoscrotal web + obesity	Local anesthetic revision of circumcision, release of penile shaft skin, and excision of penoscrotal web.	-
8	40–44	Nil	Lymphoedema and nodularity of penile shaft skin with acquired burying.	Type III	Self-injection of petroleum jelly to penile shaft	Debridement of penile shaft skin, suprapubic lipectomy, and split-thickness skin grafting of the entire penile shaft.	16/1000 inch
Patients without penile burying							
9	65–69	Nil	Severe BXO of glans. Previous conservative circumcision; remaining prepuce fused to glans.	BXO	BXO	Redo circumcision, partial glansectomy, and shaft/preputial skin flap reconstruction.	-
10	50–54	Noninsulin-dependent diabetes mellitus Elevated BMI	Severe BXO of glans penis. Previous conservative circumcision; remaining prepuce fused to glans.	BXO	BXO	Revision of circumcision, redevelopment of coronal sulcus, excision of diseased skin, and SSG to penile shaft.	16/1000 inch 5.1 × 9 cm
11	60–64	Diabetes	Skin loss secondary to debridement.	Fournier gangrene	Fournier gangrene	Initial skin debridement; interval split-thickness skin grafting.	20/1000 inch for shaft 16/1000 inch for glans
12	50–54	HS	Extensive chronic induration and lymphoedema of scrotal and penile shaft skin; "Saxophone" deformity of penis.	HS	HS	"Batman" scrotoectomy with excision of penile shaft skin, repositioning of testes, and total phallic reconstruction with SSG.	16/1000 inch 11 × 11 cm
13	70–74	Inflammatory bowel disease Immunosuppressed	Erythematous rash penile shaft length secondary to extramammary Paget disease; phimosis and balanitis.	Extramammary Paget disease	Extramammary Paget disease	Circumcision, degloving of penile shaft skin, and split-thickness skin grafting of penile shaft.	16/1000 inch
14	55–59	Prostate cancer treated with radiotherapy Nil	Chronic penile lymphoedema of unknown etiology (extensively investigated); resultant "saxophone" deformity.	Idiopathic	Idiopathic	Circumcision, degloving of penile shaft skin, and split-thickness skin grafting of penile shaft.	16/1000 inch

*Adult buried penis syndrome classification (Hess et al.^[6]).

BMI = body mass index; BXO = balanitis xerotica obliterans; SCC= squamous cell carcinoma; HS = hidradenitis suppurativa; SSG = split-thickness skin graft.

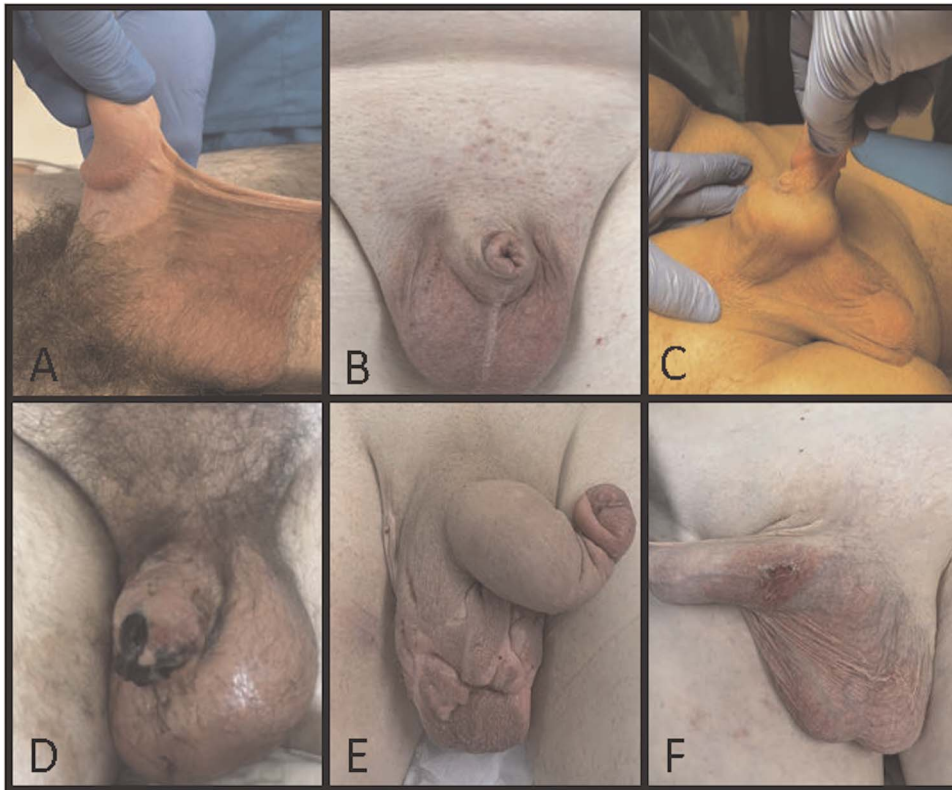


Figure 2. Preoperative photographs. (A) excess skin excision at circumcision; (B) buried penis with balanitis xerotica obliterans; (C) subcutaneous injection of silicone product; (D) Fournier gangrene; (E) hidradenitis suppurativa; (F) intraepidermal adenocarcinoma.

tissue in 13 of 14 patients and extramammary Paget disease in 1 of 14 (known preoperatively based on diagnostic biopsy). The follow-up period ranged from 3 months to 2 years. One patient returned to the surgical theater from the recovery room for redressing of a wound due to ongoing small-volume bleeding; hemostasis was achieved with compression. No other major complications were noted. One patient (patient 1) developed a small area of overgranulation at a skin graft margin, which was treated with silver nitrate. The same patient developed a mild surgical site infection of the graft, which responded well to treatment with oral antibiotics. Another patient (patient 12) experienced delayed wound healing in the context of a small perineal skin defect not amenable to primary closure. An SSG was applied, but graft take was poor and an approximately 1-inch region ultimately healed by secondary intention. Penile shaft graft take was greater than 90% in all patients who underwent SSG reconstruction. At last follow-up (mean, 6 months), cosmesis was recorded as “good,” “very good,” or “excellent” by a clinical nurse specialist and consultant urologist independently for all patients. All patients reported overall satisfaction with reconstructive outcome.

4. Discussion

Adherence to the principles of reconstructive surgery with optimization of timing and technique is imperative to achieve the best attainable functional and aesthetic outcomes in genital reconstruction.^[2] As demonstrated, select techniques can be chosen from the reconstructive armamentarium and combined to treat a myriad of genital abnormalities with an individualized approach.

We use a combination of different reconstructive techniques in the management of patients with buried penis, as a variety of underlying factors often require addressing. We find the classification system by Hesse et al.^[9] useful in distinguishing the subsets of patients presenting with adult acquired buried penis syndrome and in guiding the reconstructive approach. We have successfully combined correction of penile burying with malleable prosthesis insertion to address erectile dysfunction in a single-stage procedure, as described elsewhere.^[10]

The use of SSG to replace skin defects after excision of the skin affected by balanitis xerotica obliterans (BXO)/lichen sclerosis and from excess skin excision at previous circumcision, has been described by other authors.^[11] We have observed excellent genital graft take in these scenarios, with no recurrence of BXO in affected patients to date. We do note that none of our genital reconstruction patients affected by BXO in the presented cohort had urethral involvement.

We have observed good outcomes with SSG after skin and soft tissue debridement for Fournier gangrene as described by other authors.^[12] Although some authors advocate meshing of skin grafts in contaminated wounds,^[11] we prefer to use unmeshed skin grafts on the penile shaft as discussed previously and feel that it is reasonable to do so once the wound has been fully debrided and reconstruction is performed at an interval.

While attempts at penile self-augmentation by injection of foreign materials is a recognized occurrence, only a limited number of publications describe surgical management of its complications, which include granuloma formation, lymphoedema, and potentially systemic embolization.^[13] We have achieved

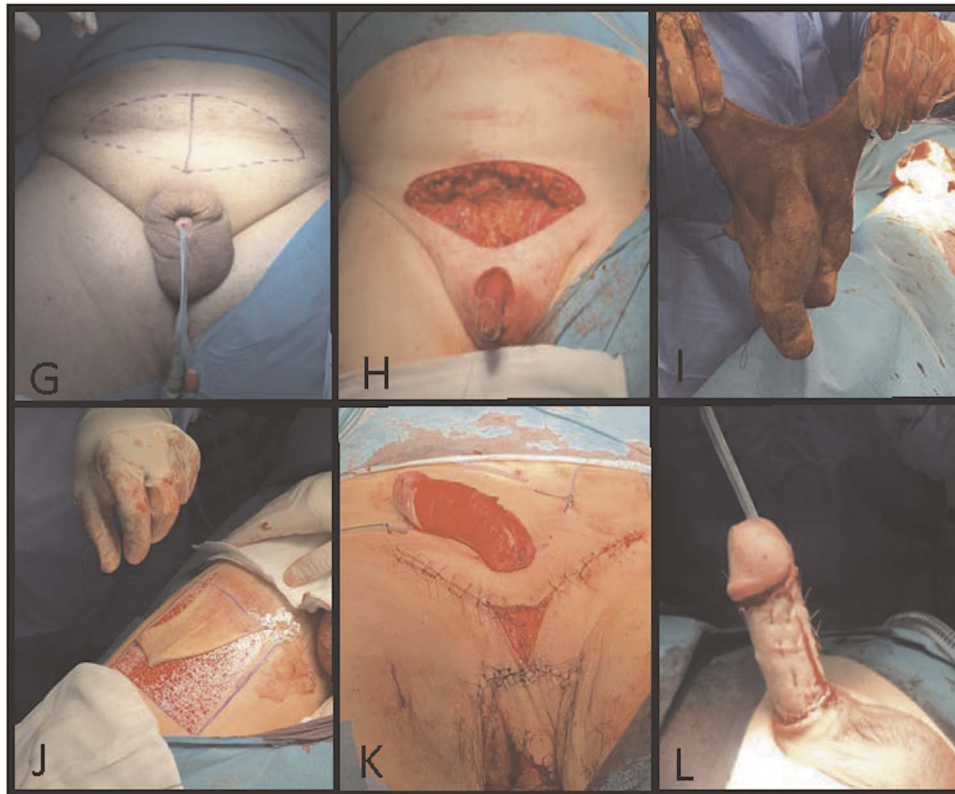


Figure 3. Intraoperative photographs. (G) preoperative skin markings for suprapubic lipectomy; (H) suprapubic lipectomy and total penile skin debridement; (I) debrided penoscrotal skin in a case of severe hidradenitis suppurativa; (J) split thickness skin graft harvest from lateral thigh; (K) penile rerouting; (L) split thickness skin grafting of penile shaft.

good results in this case with careful debridement of all involved skin and split thickness skin grafting.

Hidradenitis suppurativa (HS) is a chronic inflammatory condition of apocrine gland-bearing skin that demands active multidisciplinary management. Even with optimal medical management of the inflammatory component of the disease, residual scarring and lymphedema can result in cosmetic dissatisfaction and loss of genital function requiring surgical intervention. We advocate close liaison with dermatology colleagues in the management

of such patients, particularly surrounding perioperative management of immunomodulating medication and for ongoing care. In the case discussed here, we performed an extensive excision of all affected genital skin in the case of HS discussed here, using “Batman” skin incisions for scrotoectomy as described by Alnajjar et al.^[14] for refractory genital lymphoedema postpenile cancer treatment. Split-thickness skin graft reconstruction was performed in a similar manner described by other authors for HS^[15] and in cases of filarial lymphoedema.^[16]

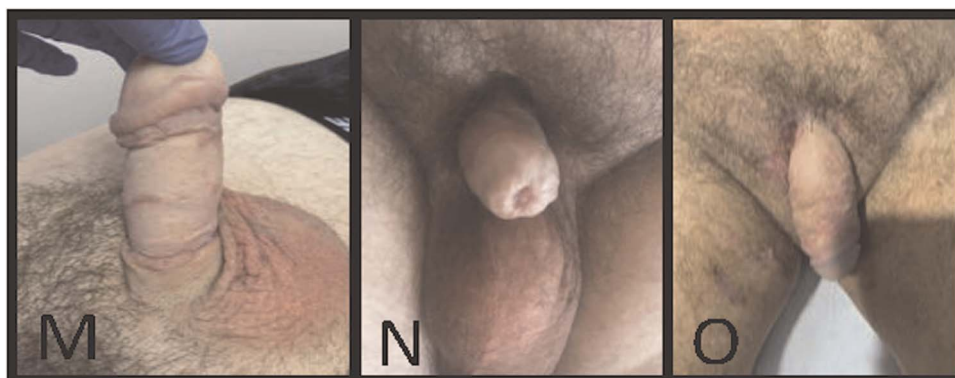


Figure 4. Postoperative photographs (at 12-week follow-up). (M) postreconstruction after excess skin excision at circumcision; (N) postreconstruction after debridement for Fournier gangrene; (O) postreconstruction after excision of diseased skin secondary to HS. HS = hidradenitis suppurativa.

We recognize that pedicled or free-flap reconstruction methods may need to be used in certain circumstances for large perineal defects, for example; however, these have not been deemed necessary or appropriate for the particular patients referred to our center in recent years.

We do acknowledge the limitations of our study design, in particular with regard to the absence of objective preoperative and postoperative aesthetic and functional outcome measures. We plan to prospectively capture these data in a standardized manner for future reconstructive cases.

5. Conclusions

An array of reconstructive techniques is available to surgeons managing nonmalignant conditions of the male external genitalia. We present our experience of operatively managing such cases, using varying combinations of techniques in an individualized, patient-tailored approach, and describe both our preoperative decision making process and surgical techniques. This study highlights the potential of this approach to achieve successful genital reconstruction for a diverse range of disease pathologies.

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Statement of ethics

This study was approved by institutional audit board review. Representative clinical photographs used were obtained with patient consent. All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Conflict of interest statement

No conflict of interest has been declared by the author.

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Nil received.

Author contributions

SMC: Planning, data collection, algorithm conceptualization, writing of manuscript;

CK: Planning, data collection;

AED: Planning, data collection;

LF: Planning, data collection;

PJD: Planning, review;

IMC: Planning, data collection, algorithm conceptualization, review of manuscript.

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