

Sexual function considerations in penile reconstructive surgery

Funzione sessuale: considerazioni in chirurgia ricostruttiva del pene

G. GARAFFA, N. CHRISTOPHER, D.J. RALPH

St. Peter's Department of Andrology, The Institute of Urology, University College London Hospitals, Ground floor, Rosenheim Wing, London, England

Key words: Peyronie's disease, Penile cancer, Balanitis xerotica obliterans, Penile trauma, Penile amputation, Penile fracture

Parole chiave: *Malattia di La Peyronie, Cancro peniena, Balanite obliterante erotica, Trauma penieno, Amputazione peniena, Frattura peniena*

Summary

The aim of this paper is to give a concise overview of surgical techniques used to manage Peyronie's disease, penile squamous cell carcinoma, penile trauma, fracture and amputation of the penis, and balanitis xerotica obliterans.

Our methodology involved a PubMed-based review of the last 20 years literature regarding the management of the above conditions. From the literature analysis we extrapolated the surgical strategies providing the best outcomes in terms of sexual function.

Riassunto

Scopo di questa minireview è fornire una panoramica delle tecniche chirurgiche utilizzate nel trattamento di: malattia di La Peyronie, carcinoma squamoso del pene, trauma e frattura peniene, amputazione del pene e balanitis xerotica obliterans.

A questo scopo abbiamo valutato la letteratura degli ultimi 20 anni presente in PubMed relativa alla chirurgia delle patologie sopramenzionate.

Nell'ambito della nostra revisione della letteratura abbiamo estrapolato le strategie chirurgiche che forniscono i migliori risultati in ambito di funzione sessuale.

Introduction

The aim of this paper is to give a concise overview of surgical techniques used to manage Peyronie's disease (PD), penile squamous cell carcinoma (SCC), penile trauma, fracture and amputation and *balanitis xerotica obliterans* (BXO). Particular attention is given to sexual function disability associated with these conditions and the expected sexual function outcome following reconstructive surgery. It is not our aim to provide detailed review of the management of these conditions and, therefore, medical management has not been discussed. It is worth noting that, excluding PD, published literature in relation to management of penile SCC, BXO and penile trauma consists mainly of retrospective, and frequently small case series.

Methods

We have performed a PubMed-based review of the literature regarding the management of PD, penile traumas, fracture or amputation, penile cancer and *balanitis xerotica obliterans*. Only papers published in the last 20 years have been considered.

Peyronie's disease

PD is a benign idiopathic condition of the penis characterised by development of a painful plaque and subsequent deviation of the penis. Up to 55% of men affected by PD will have erectile dysfunction (ED) and, conversely, PD is found in 20% of patients presenting with ED¹⁻³. The majority of men affected by this disease are in 4th and 5th decades, and in the post viagra era repre-

sent an ever-increasing group of men who expect to remain sexually active ⁴. This may, in part, explain the recently reported increased incidence of PD in a study from Cologne ⁵.

Erectile dysfunction in PD is usually caused by one or more of the following factors: psychological (performance anxiety), deformity preventing intercourse, a flail penis, or impaired penile vascular function ⁶. The physical abnormality may cause anxiety severe enough to interfere with the ability to achieve an erection. The deformity of the penis may be so severe that penetration is difficult, painful, or even impossible. This is more likely to occur if the deformity is in a ventral or lateral direction where deviation from the normal angle of vaginal penetration is maximal. Patients with particularly aggressive forms of PD may develop circumferential plaques with a degree of associated cavernosal fibrosis (Fig. 1). On erection, the affected segment lacks tumescence resulting in instability of the distal shaft; the flail penis. Finally, ED may be caused by concomitant vascular disease that occurs in 30% of patients with PD, or by veno-occlusive dysfunction ⁷. The latter has been attributed to venous leakage through emissary veins that pass through the Peyronie's plaque into the dorsal vein of the penis. Under normal circumstances, to prevent leakage and maintain tumescence, the layers of the tunica would compress these veins ⁸.

It is essential to differentiate acute inflammatory phase of PD from 'quiescent' stable phase as the treatment of the two phases varies. A short history (< 3 mos.) and pain are hallmarks of the inflammatory phase and these patients should be given a trial of medical therapy (the details of which are beyond the scope of this review). Although it is often difficult to

precisely determine when the acute phase is over, the absence of pain on erection, stable angle of deviation and long history (> 12 mos.) indicate the quiescent phase of PD ⁹.

Patients need to be informed about the natural history of this disease process as reassurance that the pain will settle, and that any deformity can be corrected can ease anxiety and may help improve sexual function. Associated ED should be documented and treated in the conventional way with oral/injectable medication or vacuum devices. Those patients whose ED does not respond to these therapies will not benefit from corrective surgical intervention ⁹. Surgical intervention for PD should be reserved for patients who find penetrative intercourse difficult or impossible. Dorsal deviation angles of up to 45% are normally well tolerated and patients able to enjoy penetrative intercourse need not be operated on. Likewise, patients with lesser but lateral or ventral curvatures, or patients who experience serious psychosexual problems as the result of a deformity, should not be denied surgical correction ⁹. Furthermore, patients with severe ED or flail penis should also be considered for surgical treatment. However, prior to embarking on any surgical correction, the plaque must be stable and the severity of the curvature determined and documented. Moreover, penile vascular and erectile function should be formally assessed ¹⁰. This is best achieved by intra-cavernosal injection of vaso-active agents alone or in combination with colour Doppler ultrasonography ¹⁰. In this way, poor candidates for surgery can be identified and unrealistic expectations can be managed.

The surgical treatment for PD falls into 2 categories: procedures that aim at correcting the penile curvature and implantation of a penile prosthesis (Table I). The choice between the two techniques is based on patients' pre-operative erectile function. Patients who do not respond to conventional treatment of ED, or patients with vascular deficit will not benefit from corrective surgery and should be offered penile implants ⁹. Patients who, on the other hand, have good erectile function or who respond to conventional treatment for ED should be offered corrective surgery which can be broadly divided into: corporoplasty and plaque excision/incision and grafting procedures.



Fig. 1. Circumferential plaque in Peyronie's disease. *Placca circumferenziale nella malattia di La Peyronie.*

Tab. I. Flow chart in surgical management of Peyronie's disease. *Indicazioni ai diversi approcci chirurgici nella malattia di La Peyronie.*

Deformity < 60° associated with good erections	Nesbit procedure
Deformity < 60° associated with mild ED	Nesbit procedure + oral or intra-cavernous agents
	cavernous agents
Deformity > 60° or complex deformity associated with good erections	Plaque incision + Grafting
Deformity > 60° or complex deformity associated with mild ED	Insertion of penile prosthesis
Deformity > 60° or complex deformity associated with mild ED associated with mild ED	
Any degree of deformity associated with ED	Insertion of penile prosthesis
Short penis	Insertion of penile prosthesis
Deformity < 60° associated with good erections	Nesbit procedure
Deformity < 60° associated with mild ED	Nesbit procedure + oral or intra-cavernous agents
Deformity > 60° or complex deformity associated with good erections	Plaque incision + Grafting
Deformity > 60° or complex deformity associated with mild ED	Insertion of penile prosthesis
Any degree of deformity associated with ED	Insertion of penile prosthesis
Short penis	Insertion of penile prosthesis

Corporoplasty, Nesbit, Nesbit-type procedures

Corporoplasty is performed under general anaesthetic through a sub-coronal incision. The penile shaft is degloved and using saline an artificial erection is induced to identify the point of maximum angulation. A longitudinal incision is made in Buck's fascia which is then carefully dissected off the *tunica albuginea* taking care not to damage the dorsal neurovascular bundle (in case of ventral curvature) or corpus spongiosum (in case of dorsal curvature) (Fig. 2a-c). An ellipse of the *tunica albuginea* is taken allowing 1 mm of width for every 10 degrees of angulation. The defect is sutured with 0 polydioxanone sutures, tying the knots on the inside. An artificial erection is induced to assess the result ⁹.

No single factor other than pre-operative erectile status predicts post-operative erectile function ¹¹. Patients with good erectile function and no vascular deficit can expect to have a successful outcome in 88-94% of cases, whereas patients with poor erectile function can expect a successful outcome in 74-77% of cases ^{9 10 12 13}. Therefore, formally assessing and documenting patients' pre-operative erectile function is recommended and will help manage patients' expectations. The penile shortening associated with corporoplasty techniques may, on rare occasions, be severe enough to make penetrative intercourse difficult ^{9 13}. However, on the whole, this procedure is simple and safe and has consistently been shown to give superior erectile function outcomes. A number of modifications to Nesbit's corporoplasty have been described ^{14 18}. Lemberger et al. and lat-



Fig. 2.

- Dissection of neurovascular bundle. *Isolamento del fascio neurovascolare.*
- Allis forceps are applied on tunica albuginea to correct curvature. *Applicazione di pinze di Allis sulla albuginea a correzione della curvatura.*
- Inverted 0 PDS suture is used to close elliptical defect in tunica albuginea. *Una sutura introflettente di 0 PDS è utilizzata per la chiusura del difetto ellittico praticato nella tunica albuginea.*

er Yachia did not remove an ellipse of the tunica, instead making one or more longitudinal incisions in the tunica, which were then sutured horizontally^{14,15}. Reported satisfaction rates varied from 79 to 95%. Others favoured simple plication techniques that could be performed under local anaesthesia without the need for dissection of either the neurovascular bundles or corpus spongiosum^{19,20}. The reported success rates for these procedures varied considerably with up to 24% recurrence rates in some series. However, with recent refinements in this technique authors have reported results comparable to Nesbit's procedure²¹.

Both early and late failure rates have been reported. Whilst early recurrences are usually secondary to the sutures having cut out, cases of delayed failure are associated with the use of absorbable suture materials which should be avoided. Although disease progression can also result in the recurrence of penile deformity, this only becomes clinically apparent after 9-15 months²².

Plaque excision/incision procedures

Devine and Horton described a penile straightening technique where the plaque is excised and the *tunica albuginea* defect is closed with a dermal graft²³. After promising initial reports, two later series showed poor long-term outcomes with significant recurrence rates and 20% incidence of post-operative ED^{24,25}. The high rate of ED associated with plaque excision has been attributed to several factors including damage to underlying erectile tissue, poor compliance of dermal grafts and veno-occlusive dysfunction secondary to new venous channel formation. Other graft materials including *temporalis fascia*, *tunica vaginalis* and synthetic materials have also been used with equally disappointing results. Consequently, plaque excision techniques are no longer recommended.

To minimise post-operative ED, Lue and El-Sakka described a technique of plaque incision using a venous graft to repair the *tunica* defect²⁶ (Fig. 3). The penis needs to be degloved mobilising Buck's fascia whilst taking care not to damage the neurovascular bundles. An H shaped incision is made in the plaque leaving a rectangular defect in the *tunica albuginea*, which is then repaired using a segment from the long saphenous vein. An artificial erection is used to confirm that straightening of the penis has been achieved. At this time, any persistent deformity may



Fig. 3. Saphenous vein patch is sutured in defect of tunica albuginea with running 4-0 PDS suture. *Un patch di vena safena è suturato in continua PDS 4-0 a chiudere il difetto nella tunica albuginea.*

be corrected with additional grafting and/or plication sutures.

The reported success rate of this procedure, in as far as straightening of the penile deformity is concerned, is very good, reaching 96% and is, therefore, comparable to Nesbit-type procedures^{26,28}. However, in the reported series, post-operative erectile dysfunction rates range from 5-12% and penile shortening can occur in up to 40% of cases, although to a lesser extent than with Nesbit-type procedures. To achieve the best results using this technique, it is very important to stretch the graft post-operatively to prevent its contracture and ultimately a poor cosmetic result. Stretching should be started after post-operative week two and carried out for at least one month and is usually achieved with the regular administration of phosphodiesterase type 5 inhibitors (PDE5i), or with the daily use of the vacuum constriction device.

To decrease operating times and patient morbidity associated with graft harvesting, a number of alternatives to venous grafts have been investigated. Both bovine pericardial and porcine small intestinal submucosal grafts have been used with excellent short-term results achieving 83-88% penile straightening rate and reporting no post-operative ED^{29,30}.

Penile implants

This is the treatment of choice for patients with severe ED who have not responded to either conventional oral/intra-cavernosal medication or vacuum



Fig. 4. Penile moulding. After prosthesis is inflated, tubing is clamped in order to protect pump and penis is forcibly bent in direction opposite to curvature for 90 sec in order to straighten shaft. Procedure can be repeated twice. *Rimodellamento penieno. Dopo attivazione della protesi i tubi sono clampati per proteggere la pompa, e il pene viene flesso vigorosamente in direzione opposta alla curvatura per 90 secondi allo scopo di raddrizzare l'asta. La procedura può essere ripetuta due volte.*

devices. It is also a reliable option for older men with vascular impairment, ED and an erectile deformity^{31 33}. In most cases of mild to moderate curvature, the insertion of the prosthesis is all that is required to straighten the penis, but in cases of severe deformity moulding, relaxing tunical incisions and grafting may be required³³ (Fig. 4). Mentor Alpha-1 and American Medical Systems CX 700 cylinders have been reported to give excellent results^{31 33}. In general, to maintain potency, patients should be offered Nesbit's procedure and, in the presence of adequate erectile function, this should be regarded as standard operation for the condition. Plaque incision techniques, on the other hand, should be reserved for patients in whom preservation of the penile length is critical or who have complex penile deformities. The choice of graft materials remains a much-debated issue.

Penile cancer

Penile cancer is rare in industrialised countries with a reported incidence between 0.1 and 0.2 in 100,000 per male population (Fig. 5). A variety of treatment options including topical 5-fluorouracil, radiotherapy, laser ablation and excision, and amputative surgery



Fig. 5. Penile cancer. *Cancro del pene.*

have been described. The published case series are small and no prospective randomised trials comparing the various therapeutic options have been published. Furthermore, very few authors have formally analysed sexual function outcome data in their series. Based on series that have attempted to ascertain psychosexual consequences of treatments for penile cancer, the impact of these treatments on patient's quality of life cannot be underestimated. Opjordsmoen et al. report that, in their series, 20% of patients met the DSM (Diagnostic and Statistical Manual of Mental Disorders) criteria for mental illness³⁴. Amongst the psychiatric conditions cited were post-traumatic stress disorder, agoraphobia, alcohol abuse and avoidant personality disorder, all of which are associated with severely reduced sexual functioning. Similarly, D'Ancona et al., studying 14 patients who had a partial penectomy, reported significantly reduced sexual functioning in 1/3rd of their patients³⁵. It is, therefore, important that both patients and doctors most carefully consider sexual function sequelae of any proposed treatment modality.

The majority of patients diagnosed with penile cancer have tumours that are minimally invasive and 80% are limited to the distal parts of the penis³⁶. From published retrospective case series, the overall and disease specific survival, in this patient group, is in excess of 90% and appears to be similar after radiotherapy, partial penectomy or local surgical excision³⁷. Treatments have generally been selected based on local customs and available expertise.

The traditional surgical treatment is either partial or total penile amputation depending on the size of the tumour and its position, and allowing for a 2 cm proximal margin of clearance to ensure local onco-

logical control³⁸. The aim of a partial resection is to leave enough length to allow upright voiding and to give a chance for penetrative intercourse. In reality, however, once the 2 cm surgical margin has been obtained many patients found the length of the remaining stump inadequate for either upright urination or penetrative intercourse. It is, therefore, not surprising that 8/13 patients who had undergone either partial or total amputation, in the series of Opjordsmoen et al., described their Sexual Ability as either severely problematic or lacking, whilst 10 patients reported a markedly reduced or total lack of Sexual Enjoyment following amputative surgery³⁴. In another study by Romero et al., where a majority of patients sustained the same frequency and sexual desire as before surgery, only 55% retained enough erectile function to allow penetrative intercourse³⁹. Mazza and Cheliz reported that in their series of partial penectomies, only 20% retained their pre-operative potency⁴⁰. Clearly, conventional amputative surgery, although from an oncological point of view very successful, gives poor psychological and anatomical/functional results.

Consequently, several authors have challenged the traditional 2 cm margin of clearance and novel surgical techniques that combine local excision with reconstruction have been described⁴¹⁻⁴². Hatzichristou et al. reported on a series of 7 patients with distal, low-grade tumours on whom glansectomy was performed instead of the conventional partial penectomy⁴³. All patients retained their pre-operative erectile function and resumed normal sexual functioning. Similarly, Davis et al. reported that in all their patients who had undergone glansectomy, the pre-operative sexual function was maintained⁴⁴.

Partial or total glansectomy (with or without graft re-

construction) aims to preserve as much of the functional anatomy as possible without compromising local oncological control. The aim is total tumour clearance using intra-operative frozen sections to ensure microscopic tumour clearance. As all distal T1 and T2 tumours confined to the glans penis are amenable to these techniques, the vast majority of patients diagnosed with penile cancer, in the western world, can be considered for this treatment. In cases where the tumour extends into the corpora, distal corporectomy is performed followed by corporal reconstruction with formation of a neo-glans using either split (SSG) or full thickness skin grafts (FTSG) (Fig. 6a-c). Although, so far, only short-term results have been published, the local recurrence rates are comparable to those following other treatment modalities and the sexual function (as yet unpublished) is good, with many patients reporting erection at first post-operative consultation⁴⁵.

The follow-up of these patients needs to be meticulous and a multidisciplinary approach to the care of these patients is necessary. It is, therefore, preferable that patients diagnosed with penile tumours be referred to centres that can offer this expertise as this will not only ensure the best possible outcome for the patients concerned but also facilitate data collection.

Penile Trauma

Trauma to the genital area is uncommon and rarely occurs in isolation⁴⁶⁻⁴⁸. Detailed history of the mechanism of injury and thorough clinical examination are important in the initial assessment of the injured patient⁴⁹. Although penile injuries may cause significant blood loss, other causes of shock need to be sought and excluded. Initial management must in-



Fig. 6.

a. Glansectomy. *Glandectomia*.

b. Split thickness skin graft is applied to tip of corpora to fashion neoglans. *Applicazione di graft cutaneo "split thickness" all'apice dei corpi cavernosi, a formare un neoglande*.

c. Post-operative result. *Risultato post-operatorio*.

clude resuscitation and stabilization of the patient. Once these issues have been successfully dealt with, attention should be focused on correctly diagnosing the nature of the penile injury and instituting appropriate surgical treatment. This strategy will not only minimise long-term complications but also prevent missing life-threatening injuries.

Penetrating penile trauma

These injuries require prompt surgical exploration to assess the extent of injury and prevent long-term complications⁴⁹. Judicious debridement of the wounds should be carried out saving as much tissue as possible. Associated urethral injury that occurs in 25% of patients should be ruled out by performing a urethrogram^{46,48}. *Corpora cavernosa* and urethral injuries should be debrided and primarily repaired. Most patients sustaining low velocity trauma (e.g. hand gun, knife) can expect to maintain normal erectile and voiding function following reconstructive surgery^{47,48}.

In most instances, superficial soft tissue loss can be compensated for by the inherent elasticity of the penile shaft skin and primary approximation can be achieved. For cases where tissue loss exceeds elastic potential of the skin, grafting techniques need to be employed. The choice of graft material lies between split thickness (SSG) and full thickness skin grafts (FTSG). SSGs are quicker to harvest, need less preparation and take more reliably, but tend to contract more than FTSGs. Furthermore, FTSGs are preferred as they are more resistant to trauma from intercourse and give better cosmetic results⁵⁰. The choice of donor site depends on the surgeon's experience and pattern of injury and includes the buttock, thigh and underarm. Deeper defects may require free or pedicled flaps, especially if later insertion of penile prosthesis is anticipated. Coexistent *tunica albuginea* defects, too large for primary repair, can be patched with sections of the saphenous vein. Depending on circumstances, grafting can be delayed until the local tissue condition has been optimised.

Penile avulsion and amputation

Penile amputation is an uncommon injury resulting, most frequently, from self-mutilation and, on occasions, from industrial accidents (Fig. 7). The aim, in all cases, should be surgical re-implantation^{49,51}. The



Fig. 7. Penile fracture. Tear of corpora and urethra is evident. Frattura del pene. È evidente la lacerazione dei corpi cavernosi e dell'uretra.

amputated phallus should be preserved under hypothermic conditions taking care to avoid desiccation of tissue and direct contact with ice⁵¹. Haemorrhage from the penile stump should be controlled by direct pressure, in the first instance, resorting to the use of tourniquets only when that fails. This will minimise any further tissue damage maximising the final penile length.

Initial efforts to return the amputated phallus to its anatomical position were carried out without the use of an operating microscope. Carroll et al., reporting on 38 patients who had penile re-implantation, found that all patients retained adequate erectile function to permit penetrative intercourse, despite the fact that all patients lost normal penile sensation⁵². The authors also noted a high urethral stricture rate in excess of 50%. By comparison, later data from 21 pooled cases of microsurgical repair showed a stricture rate of 25%^{51,52}. Furthermore, 15 patients had retained their pre-operative erectile function, with a further 4 patients reporting good, although decreased, erectile function. Microsurgical repairs should, therefore, be seen as standard care in cases of penile amputation.

At surgery, the *corpora cavernosa* and urethra are aligned and repaired, followed by the anastomosis of dorsal penile arteries, dorsal veins and dorsal nerves. Several authors have noted that erectile function is worse when the cavernosal arteries are anastomose^{51,52}. Only 3/6 (50%) patients who had cavernosal artery anastomosis maintained erectile function in contrast to 12/14 (86%) patients who only had dorsal artery anastomosis. This may reflect

the magnitude of corporal dissection to free an adequate length of cavernosal artery required for anastomosis. The ensuing cavernosal fibrosis may further worsen an already compromised system. Notably repair of the dorsal nerves with return of penile sensation had no bearing on the quality of erectile function⁵¹.

In cases where the amputated phallus cannot be found or is unsuitable for re-implantation the remaining *corpora* are debrided and closed as when performing a partial penectomy. Dividing the suspensory ligament and performing a v-y plasty may lengthen the remaining stump. Formal reconstructive procedures such as radial artery phalloplasty or pubic phalloplasty should only be considered where the above procedures have failed.

Penile fracture

Penile fractures, rupture of the *tunica albuginea* of the *corpora cavernosa*, most commonly occur during vigorous intercourse or masturbation^{53 54} (Fig. 8). The diagnosis is made on typical history of cracking sound, followed by immediate pain and detumescence. On examination, the penis is flaccid, swollen and the bruising extends to the scrotum and perineum in a characteristic butterfly pattern. Ultrasonography (US), cavernosography, retrograde urethrography and magnetic resonance imaging (MRI) have been used to aid diagnosis^{55 57}. In reality, none of these investigations are recommended since definitive diagnosis is made on surgical exploration⁴⁹. Other diagnoses that need to be considered include rupture of deep dorsal vein or dorsal artery injury. Hinev et al. compared immediate surgical repair against delayed or non-surgical management⁵⁸. In



Fig. 8. Penile amputation. *Amputazione del pene*.

their series of 25 patients, 17 underwent immediate repair, 6 had delayed repair and 2 refused surgical intervention. None of the patients who had immediate repair suffered any long-term sexual function complications, whilst those who had either delayed or non-surgical management developed long-term complications that included penile aneurysm, curvature and ED. Others have confirmed these findings and, at present, immediate repair is the treatment of choice with a low incidence of long-term erectile complications^{59 60}. Surgical exploration is best performed through a subcoronal incision and degloving of the penile shaft. Opening Buck's fascia at the site of maximal haematoma will lead to tunica rupture. The haematoma should be evacuated, corpora washed out and torn edges debrided. Either a continuous or interrupted suture technique can be employed, provided slowly absorbable suture material is used. Inducing artificial erection checks integrity of the repair and helps detect any occult injuries. Exploration through a local incision is ill advised, as the exposure is inadequate to allow inspection of the entire shaft or urethra, which may be injured in up to 20% of cases^{49 61}. Circumcision is usually performed.

Balanitis xerotica obliterans

Balanitis xerotica obliterans (BXO), or male genital form of *lichen sclerosus* (Fig. 9), is a chronic inflammatory skin condition of unknown aetiology. Genetic factors, autoimmune conditions and a variety of infective agents have been suggested as potential aetiological factors but these have remained unconfirmed. The precise incidence of BXO is difficult to



Fig. 9. Balanite xerotica oblierans. *Balanite xerotica oblierans*.

determine as in many instances the disease runs an uncomplicated course and patients may not seek medical attention, but it is not uncommon.

Clinical presentation varies from minor white discoloration of the glans and prepuce to severe scarring causing phimosis, preputial adhesions, meatal stenosis and urethral strictures. The involved areas become inelastic and prone to fissuring and bleeding during sexual activity. In aggressive cases, both the glans and prepuce may ulcerate, causing adhesions that eventually obliterate the space between them. The diagnosis is usually established on clinical grounds alone but in severe cases, refractory to treatment, early biopsy is recommended to exclude associated penile carcinoma⁶².

BXO can be treated either medically or surgically. Although medical treatment with topical steroids has a high response rate, cure is seldom achieved^{63 64}. Surgery, on the other hand, offers more definitive treatment with very high cure rates. In the series of Depasquale et al. comprising 500+ consecutive cases > 90% of patients with BXO, limited to the glans and prepuce, were cured with circumcision alone⁶⁵. Technically, circumcision in patients with BXO may be difficult due to preputial adhesions and failure to separate these may lead to inadequate exposure of the glans and precipitate recurrence of symptoms. Nevertheless, in spite of adequate circumcision some patients (4%) will go on to develop progressive disease of the glans⁶⁵. The best option in these difficult cases is glans resurfacing where the entire glans epithelium is removed⁶⁵ (Fig. 10a-c). Spongy tissue is then covered with a partial thickness skin graft. Although no specific erectile or sexual function assessments have been performed, the authors have reported good cosmetic and functional results.

Involvement of the meatus and urethra by BXO is not uncommon occurring in up to 20% of cases in some series⁶⁵. The technical challenge is to ensure free passage of urine whilst, at the same time, minimising recurrence rates and erectile dysfunction. BXO of the distal urethral margin, causing meatal stenosis, may respond to a combination of circumcision and meatoplasty or laser ablation⁶⁶. If, on the other hand, BXO involves the distal urethra this approach is likely to fail with inevitable re-stricturing⁶⁵.

Once the urethra is involved, excision of the affected segment and substitution urethroplasty is the treatment of choice⁶⁷. Various ways of reconstructing the urethra have been attempted, including inlay flaps and grafts, genital and extra-genital skin grafts and buccal/bladder mucosa grafts. It is now well es-



Fig. 10. Glans resurfacing.

- a. Epithelium involved is excised. *Escissione dell'epitelio coinvolto.*
- b. Split thickness skin graft is applied. *Applicazione graft cutaneo "split thickness".*
- c. Post-operative result. *Risultato post-operatorio.*

tablished that any form of skin graft invariably leads to recurrence of strictures as a result of recurrent BXO. This does not appear to be a problem with mucosa grafts.

Coursey et al. studied 200 patients who had anterior urethroplasty comparing sexual function in those who had either anastomosis or buccal mucosa graft or penile flap and circumcision⁶⁸. They reported that patients most at risk of having post-operative ED were those who had penile flaps and those who had long strictures. They concluded that overall, patients were not more likely to have ED following an anterior urethroplasty than those undergoing circumcision.

Kessler et al. studied 267 consecutive patients who had undergone urethroplasty in their centre⁶⁹. Anastomotic procedures were associated with higher incidence of significant penile shortening, marked or severe impairment in erectile function and marked or severe impairment in sexual life. Patients treated with buccal mucosa graft, on the other hand, reported no or little impairment in sexual life. It is noteworthy that the authors also recommended that patients be counselled regarding not only the aforementioned ED but also the penile curvature and

shortening. It is generally accepted that buccal mucosa graft substitution urethroplasty is the procedure of choice for patients with BXO-associated urethral strictures. This ensures low recurrence rates and high rates of preserving normal erectile function.

Conclusions

To achieve best sexual function outcomes, patients with PD who have good pre-operative erectile function should be offered a Nesbit type procedure. Those patients for whom preservation of length is vital or who have a complex deformity will obtain the best results with tunica incision and grafting procedure. The majority of patients with penile SCC can be offered novel organ-preserving treatment with good functional results. Penile trauma is rare and, therefore, challenging to treat, but with early surgical intervention nearly all patients can expect to have a satisfactory outcome. Finally, to maximise erectile function and limit stricture recurrence rates patients with BXO should be offered buccal mucosa graft substitution urethroplasty.

References

- Schwarzer U, Sommer F, Klotz T, Braun M, Reifenrath B, Engelmann U. *The prevalence of Peyronie's disease: results of a large survey*. BJU Int 2001;88:727-30.
- Kadioglu A, Tefekli A, Erol B, Oktar T, Tunc M, Tellaloglu S. *A retrospective review of 307 men with Peyronie's disease*. J Urol 2002;68:1075-9.
- Amin Z, Patel U, Friedman EP, Vale JA, Kirby R, Lees WR. *Colour Doppler and duplex ultrasound assessment of Peyronie's disease in impotent men*. Br J Rad 1993;66:398-402.
- Pryor JP, Ralph DJ. *Clinical presentations of Peyronie's disease*. Int J Impot Res 2002;14:414-7.
- Schwarzer U, Sommer F, Klotz T, Braun M, Reifenrath B, Engelmann U. *The prevalence of Peyronie's disease: results of a large survey*. BJU Int 2001;88:27-30.
- Pryor JP. *Peyronie's disease and impotence*. Acta Urol Belg 1988;56:317-21.
- Chilton CP, Castle WM, Westwood CA, Pryor JP. *Factors associated in the aetiology of Peyronie's disease*. Br J Urol 1982;54:748-50.
- Gasior BL, Levine FJ, Howanessian A, Krane RJ, Goldstein I. *Plaque-associated corporal veno-occlusive dysfunction in idiopathic Peyronie's disease. A pharmacocavernosometric and pharmacocavernosographic study*. World J Urol 1990;8:90-6.
- Ralph DJ, Al-Akraa M, Pryor JP. *The Nesbit operation for Peyronie's disease: 16-year experience*. J Urol 1995;154:1362-3.
- Montorsi F, Guazzoni G, Bergamaschi F, Consonni P, Rigatti P, Pizzini G, et al. *Vascular abnormalities in Peyronie's disease. The role of colour Doppler sonography*. J Urol 1994;151:373-5.
- Levine LA, Greenfield JM, Estrada CR. *Erectile dysfunction following surgical correction of Peyronie's disease and a pilot study of the use of Sildenafil citrate rehabilitation for postoperative erectile dysfunction*. J Sex Med 2005;2:241-7.
- Porst H. *Congenital and acquired penile deviations and penile fracture*. In: Porst H, editor. *Penile Disorders*. Berlin, Heidelberg: Springer-Verlag 1997, pp. 37-56.
- Savoca G, Trombetta C, Ciampalini S, De-Stefani S, Buttazzi L, Belgrano E. *Long-term results with Nesbit's procedure as treatment of Peyronie's disease*. Int J Impot Res 2000;12:289-93.
- Lemberger RJ, Bishop MC, Bates CP. *Nesbit's operation for Peyronie's disease*. Br J Urol 1984;56:721-3.
- Yachia D. *Modified corporoplasty for the treatment of penile curvature*. J Urol 1990;143:80-2.
- Saissine AM, Wespes E, Schulman CC. *Modified corporoplasty for penile curvature: 10 years experience*. Urology 1994;44:419-21.
- Licht MR, Lewis RW. *Modified Nesbit procedure for the treatment of Peyronie's disease: a comparative outcome analysis*. J Urol 1997;58:460-3.
- Rehman J, Benet A, Minsky LS, Melman A. *Results of surgical treatment for abnormal penile curvature: Peyronie's disease and congenital deviation by a modified Nesbit plication (tunica shaving and plication)*. J Urol 1997;157:1288-91.

- 19 Nooter RI, Bosch JLHR, Schröder FH. *Peyronie's disease and penile curvature: long-term results of operative treatment with the plication procedure*. Br J Urol 1994;74:497-500.
- 20 Van-Der-Drift DGF, Vroeghe JA, Groenendijk PM, Slob AK, Schröder FH, Mickisch GHJ. *The plication procedure for penile curvature. surgical outcome and postoperative sexual functioning*. Urol Int 2002;69:120-4.
- 21 Gholami SS, Lue TF. *Correction of penile curvature using the 16-dot plication technique: a review of 132 patients*. J Urol 2002;167:2066-9.
- 22 Andrews HO, Al-Akraa M, Pryor JP, Ralph DJ. *The Nesbit operation for Peyronie's disease. An analysis of the failures*. BJU Int 2001;87:658-60.
- 23 Devine CJ, Horton CE. *Surgical treatment of Peyronie's disease with a dermal graft*. J Urol 1974;111:44-9.
- 24 Bystrom J, Alfthan O, Gustafson H, Johansson B. *Early and late results after excision and dermo-fat grafting for Peyronie's disease*. Prog Reprod Biol 1972;9:78-84.
- 25 Austoni E, Colombo F, Mantovani F, Patelli E, Fenice O. *Chirurgia radicale e conservazione dell'erezione nella malattia di La Peyronie*. Arch Ital Urol 1995;67:359-64.
- 26 Lue TF, El-Sakka AI. *Venous patch graft for Peyronie's disease. Part I. Technique*. J Urol 1998;160:2047-9.
- 27 El-Sakka AI, Rashwan HM, Lue TF. *Venous patch graft for Peyronie's disease. Part II. Outcome analysis*. J Urol 1998;160:2050-3.
- 28 Akkus E, Ozkara H, Alici B, Demirkesen O, Akaydin A, Hattat H, Solok V. *Incision and venous patch graft in the surgical treatment of penile curvature in Peyronie's disease*. Eur Urol 2001;40:53-6.
- 29 Egydio-Paulo H, Lucon-Antônio M, Arap S. *Treatment of Peyronie's disease by incomplete circumferential incision of the tunica albuginea and plaque with bovine pericardium graft*. Urology 2002;59:570-4.
- 30 Knoll LD. *Use of porcine small intestinal submucosal graft in the surgical management of Peyronie's disease*. Urology 2001;57:753-7.
- 31 Carson CC. *Penile prosthesis implantation in the treatment of Peyronie's disease*. Int J Impot Res 1998;10:125-8.
- 32 Eigner EB, Kabalin JN, Kessler R. *Penile implants in the treatment of Peyronie's disease*. J Urol 1991;145:69-71.
- 33 Wilson SK, Cleves MA, Delk JR. *Long-term follow-up of treatment for Peyronie's disease: modelling the penis over an inflatable penile prosthesis*. J Urol 2001;165: 825-9.
- 34 Opjordsmoen S, Fossa SD. *Quality of life in patients treated for penile cancer. A follow-up study*. Br J Urol 1994;74:652-7.
- 35 D'Ancona CA, Botega NJ, De Moraes C, Lavoura NS Jr., Santos JK, Rodrigues Netto N Jr. *Quality of life after partial penectomy for penile carcinoma*. Urology 1997;50:593-6.
- 36 Sarin R, Norman A, Steel G, Horwich. *Treatment results and prognostic factors in 101 men treated for squamous carcinoma of the penis*. Int J Radiation Oncol Biol Phys 1997;38:713-22.
- 37 Horenblas S, van Tinteren H. *Squamous cell carcinoma of the penis. IV. Prognostic factors of survival: analysis of tumor, nodes and metastasis classification system*. J Urol 1994;151:1239-43.
- 38 Schellhammer PF, Jordan GH, Robey EL, Spaulding JT. *Tumors of the penis*. In: Walsh PC, Retik AB, Stamey TA, Vaughan ED, editors. *Campbell's Urology, vol. II*. 6th edn. Philadelphia: WB Saunders 1992, pp. 1264-1298.
- 39 Romero FR, Romero KR, Mattos MA, Garcia CR, Fernander R de C, Perez MD. *Sexual function after partial penectomy for penile cancer*. Urology 2005;66:1292-5.
- 40 Mazza ON, Cheliz GM. *Glanuloplasty with scrotal flap for partial penectomy*. J Urol 2001;166:887-9.
- 41 Hoffman M, Renshaw A, Loughlin K. *Squamous cell carcinoma of the penis and microscopic pathologic margins. How much margin is needed for local cure?* Cancer 1999;85:1565-8.
- 42 Agrawal A, Pai D, Ananthakrishnan N, Smile SR, Ratnakar C. *The histological extent of the local spread of carcinoma of the penis and its therapeutic implications*. BJU Int 2000;85:299-300.
- 43 Hatzichristou DG, Apostolidis A, Tzortzis V, Hatzimouratidis K, Ioannides E, Yannakoyorgos K. *Glansectomy: an alternative surgical treatment for Buschke-Lowenstein tumours of the penis*. Urology 2001;57:966-99.
- 44 Davis JW, Schellhammer PF, Schlossberg SM. *Conservative surgical therapy for penile and urethral carcinoma*. Urology 1999;53:386-92.
- 45 Pietrzak P, Corbishley C, Watkin N. *Organ-sparing surgery for invasive penile cancer: early follow-up data*. BJU Int 2004;94:1253-7.
- 46 Gomez RG, Castanheira ACC, McAninch JW. *Gunshot wounds to the male genitalia*. J Urol 1993;150:1147-9.
- 47 Cline KJ, Mata JA, Venable DD, Eastham JA. *Penetrating trauma to the male genitalia*. J Trauma 1998;44:492-4.
- 48 Goldman HB, Dmochowski RR, Cox CE. *Penetrating trauma to the penis: functional results*. J Urol 1996;155:551-3.
- 49 Morey AF, Metro MJ, Carney KJ, Miller KS, McAninch JW. *Consensus on genitourinary trauma: external genitalia*. BJU International 2004;94:507-15.
- 50 Summerton DJ, Christopher, AN, Minhas S, Ralph DJ. *Penile reconstruction with the use of skin grafting: P150*. BJU International 2005;95(Suppl 5):104.
- 51 Jezior J, Brady J, Schlossberg SM. *Management of penile amputation injuries*. World J Surg 2001;25:1602-9.
- 52 Carroll P, Lue TF, Schmidt R, Trengrove-Jones G, McAninch JW. *Penile replantation: current concepts*. J Urol 1985;133:281-5.
- 53 Klein FA, Smith V, Miller N. *Penile fracture. Diagnosis and management*. J Trauma 1985;25:1090-2.
- 54 Nicolaisen GS, Melamud A, McAninch JW. *Rupture of the corpus cavernosum: surgical management*. J Urol 1983;130:917-9.
- 55 Pliskow RJ, Ohme RK. *Corpus cavernosography in active fracture of the penis*. Am J Roentgenol 1979;133:331-2.
- 56 Dierks PR, Hawkins H. *Sonography and penile trauma*. J Ultrasound Med 1983;2:417-9.
- 57 Choi MH, Kim B, Ryu JA. *MR Imaging of acute penile fracture*. Radiographics 2000;20:1397-405.
- 58 Hinev A. *Fracture of the penis: treatment and complications*. Acta Med Okayama 2000;54:211-6.

- ⁵⁹ Haas CA, Brown SL, Spirnak JP. *Penile fracture and testicular rupture*. World J Urol 1999;17:101-6.
- ⁶⁰ El-Bahnasawy MS, Gomha MA. *Penile fractures: the successful outcome of immediate surgical intervention*. Int J Impot Res 2000;12:273-7.
- ⁶¹ Mydlo JH. *Surgeon experience with penile fracture*. J Urol 2001;166:528-9.
- ⁶² Pietrzak P, Hadway P, Corbishley CM, Watkin NA. *Is the association between balanitis xerotica obliterans and penile carcinoma underestimated?* BJU Int 2006;98:74-6.
- ⁶³ Wright JE. *The treatment of childhood phimosis with topical steroid*. Australian NZ J Surg 1994;64:327-8.
- ⁶⁴ Fischer GO. *Lichen sclerosus in childhood*. Australasian J Dermatol 1995;36:166-7.
- ⁶⁵ Depasquale I, Park, AJ, Bracka A. *The treatment of balanitis xerotica obliterans*. BJU Int 2000;86:459-65.
- ⁶⁶ Windahl T, Hellsten S. *Carbon dioxide laser treatment of lichen sclerosus et atrophicus*. J Urol 1993;150:868-70.
- ⁶⁷ Venn SN, Mundy AR. *Urethroplasty for balanitis xerotica obliterans*. Br J Urol 1998;81:735-7.
- ⁶⁸ Coursey JW, Morey AF, McAninch JW, Summerton DJ, Seccrest C, White P, Miller K, et al. *Erectile function after anterior urethroplasty*. J Urol 2001;166:2273-6.
- ⁶⁹ Kessler TM, Fisch M, Heitz M, Olianias R, Schreiter F. *Patient satisfaction with the outcome of surgery for urethral stricture*. J Urol 2002;167:2507-11.

1. Which of the following procedures presents the highest incidence of erectile dysfunction?

- a. Nesbit procedure
- b. Plaque incision and venous grafting
- c. Plaque excision and grafting

2. Which type of procedure would you offer to a patient with mild erectile dysfunction and a complex penile deformity?

- a. Nesbit procedure
- b. Insertion of a penile prosthesis
- c. Plaque incision and venous grafting

3. In which patient would you offer a plaque incision and venous grafting?

- a. In a patient with a deformity < 60 degrees with good pre-operative erectile function and adequate penile length
- b. In a patient with complex deformity and poor pre-operative erectile function
- c. In a patient with a deformity > 60 degrees and adequate pre-operative erectile function

4. How would you manage a patient with penile trauma?

- a. It is paramount to collect a detailed history of the mechanism of injury and to perform a thorough clinical examination to exclude lesions of other organs.
- b. It is sufficient to concentrate on the penile trauma, since this condition usually occurs in isolation
- c. Surgical treatment should always be avoided

5. Which is the best management for penile fractures?

- a. Delayed surgical treatment
- b. Immediate surgical treatment
- c. Conservative management

6. The management of penile amputation involves:

- a. Direct anastomosis of *corpora cavernosa*, urethra, dorsal penile arteries, dorsal veins and dorsal nerves
- b. Anastomosis of the corpora and of the urethra
- c. Anastomosis of the corpora, the urethra and the dorsal vessels

7. Which is the exact incidence of BXO?

- a. 15%
- b. 20%
- c. We do not have a precise incidence since the presentation is very variable and, therefore, some of the patients affected by this condition seek medical attention

8. Which is the clinical presentation?

- a. It varies from uncomplicated cases to severe scarring causing phimosis, preputial adhesions, meatal stenosis and urethral strictures
- b. Phimosis and meatal strictures
- c. Discolouration of glans and prepuce

9. Which is the first choice treatment for urethral strictures?

- a. Conservative treatment with topical steroids
- b. Buccal mucosa urethroplasty
- c. Urethrotomy