Original Article

Autograft, but with What? Contemporary Practice of Incision/Excision and Autografting in Peyronie's Disease Treatment

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ABSTRACT

Introduction: Peyronie's disease (PD) is characterized by the development of fibrous plaques within the tunica albuginea, leading to penile deformity and significant psychological distress. While various surgical options exist, plaque incision or excision with grafting remains the gold standard for correcting complex or severe curvatures (>60–70°). This review evaluates the clinical outcomes, technical success, and complication rates of various autograft materials.

Historically, dermal grafts were the first autografts used but have fallen out of favor due to high rates of penile shortening (45–70%) and de novo ED (up to 66.7%). Saphenous vein grafts (SVG) demonstrate an initial success rate of ~85.6%, though long-term follow-up indicates a decline in straightness and rising ED rates (22.5%). Tunica albuginea and tunica vaginalis grafts show high technical success (90–100%) with low metabolic demand. More contemporary options, specifically fascia (lata and temporalis) and buccal mucosa grafts (BMG), show superior outcomes. Fascia grafts report technical success rates near 100% with minimal shortening. BMG demonstrates a 94.1% success rate with low de novo ED (0–10%) and rapid tissue integration.

Keywords: Peyronie's Disease; Autografts, Corporoplasty; Penile Plaque; Erectile Dysfunction

Introduction

Peyronie's disease (PD) was originally referred to as induratio penis plastica. Peyronie eponym is attributed to Francois Gigot de la Peyronie, who provided the first description and treatment options for the condition in 1743 (1). The current knowledge of the underlying mechanism causing Peyronie's disease involves an atypical healing process of the tunica albuginea, resulting in excessive fibrosis and the development of plaques (2). The prevailing belief is that sexual activity is the primary cause of Peyronie's disease, as it can result in buckling of the penis, leading to repetitive microvascular damage, which sets off a process of collagen deposition that ultimately leads to the development of plaques within the tunica albuginea of the penis (3). The presence of this noticeable plaque leads to the emergence of various penile deformities, such as curvature, shortening, indentation, or hourglass deformity.

The incidence of PD differs significantly based on the group of individuals being examined, typically between 3% and 9%, and could be even greater among individuals who have diabetes or who have undergone radical prostatectomy (4-6).

Several symptoms of PD might bring the patient to the physician, including pain, particularly during erection, palpable nodularity on the penile shaft, shortening of the penis, curvatures causing asymmetry of the penis, and erectile dysfunction (7). Peyronie's disease is a condition that not only causes physical deformity but also has a significant psychological impact. The likelihood of men with Peyronie's disease being diagnosed with negative mental health outcomes is higher. A large recent survey revealed that PD patients had an increased risk of having depression, anxiety disorder, substance abuse, and self-injurious disorders (8).

Classically, PD has two phases: an acute inflammatory phase and a chronic stable phase (9). During the acute phase, erections are painful, and the plaque is in transition, with resultant changes in the shape of the penile deformity. The chronic phase is usually described as the disappearance of pain and relative stability of the deformity (10). Spontaneous resolution of the penile deformity has been reported, though very rarely.

Although myriad medical approaches prevail, surgical treatment is the current gold standard in the management of PD.

Surgical treatment of PD

Surgery still remains the treatment of choice for reliably correcting established curvatures and complex defects. Indications for surgery in PD are shown in table-1.

Table-1. Indications for surgical treatment of Peyronie's disease

Stable disease*
Failure of conservative treatment
Adequate erectile rigidity with or without pharmacotherapy or VED
Significant deformity precluding satisfactory sexual intercourse
Patient preference for the most rapid and reliable result

**Stable disease is defined as stability of penile curvature for at least 3-6 months with a minimum symptom duration of 12 months (11).*

Three main surgical approaches are available for the treatment of PD, namely plication, plaque incision/excision and grafting, and penile prosthesis placement with/without straightening surgery. Each surgical modality has its advantages and disadvantages and special indications in some patient populations. The major forms of surgical procedures, along with attended pros and cons, are shown in table-2.

Table-2. Major surgical options in Peyronie's disease

Surgical method	Advantages	Disadvantages
Plication	Shorter operation time Satisfactory cosmetic outcomes Low risk for postoperative ED	Penile shortening Failure to correct complex lesions such as hinge or hourglass effects

Surgical method	Advantages	Disadvantages
Plaque incision/excision with grafting	It may address more complex lesions and curvatures >70 degrees	Requires a good level of erection before the procedure due to increased ED risk
Penile prosthesis placement with/without straightening surgery	Only effective method in PD patients with preoperative ED.	• Requires straightening techniques in addition to prosthesis placement • Penile shortening

Plaque incision/excision with grafting

This PD surgical procedure was devised for a few reasons. First, many patients are not happy with penile length loss associated with plication techniques. In addition, plication was not a proper method for complex lesions and more severe penile curvatures (typically more than 60-70 degrees). Thus, the surgeon partially excises plaque or makes a plaque incision in the shape of H or double-Y in the area of maximum curvature. The newly occurred tissue defect is patched by the graft material. In this way, the surgeon tries to maintain penile shaft caliber and correct the curvature. Indications for plaque incision/excision with grafting are depicted in table-3.

Table-3. Indications for plaque incision/excision with grafting

Indications for plaque incision/excision with grafting
• Advanced curvatures (>60-70 degrees) • Shaft narrowing • Complex lesion (Hourglass and hinge deformity) • Extensive plaque calcification • Absence of preoperative ED • Patient preference (especially concerns with penile shortening with plication procedures)

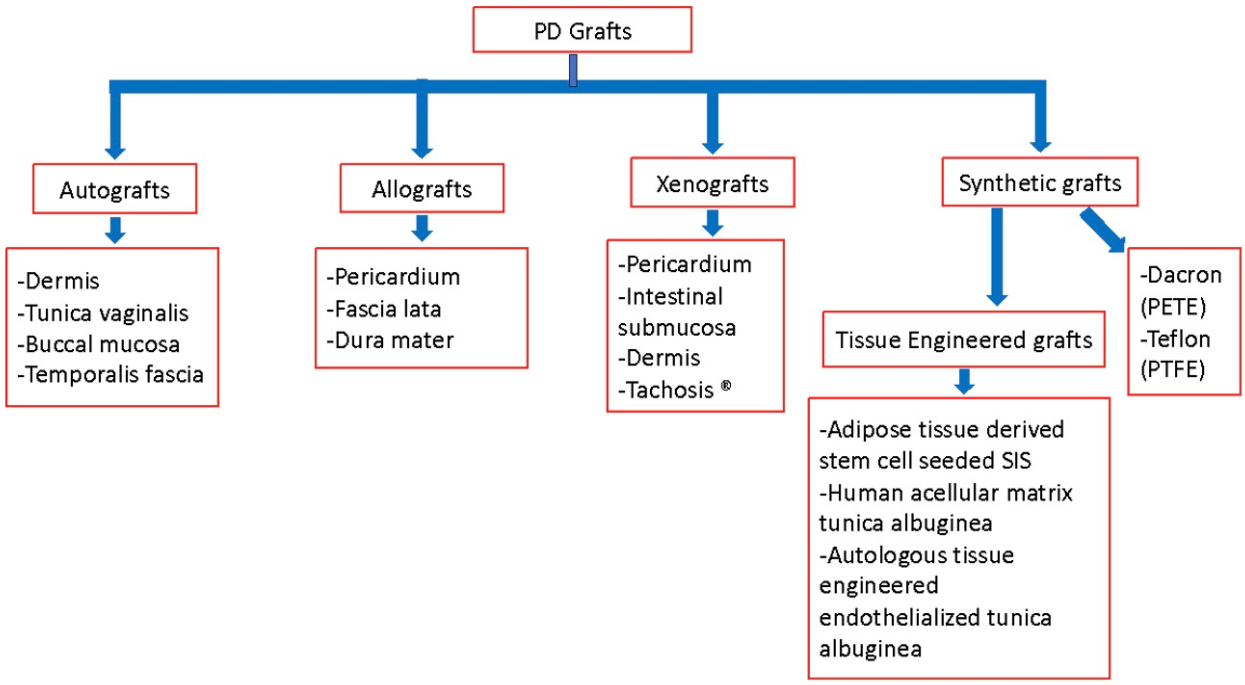
One of the most important issues when selecting PD patients for plaque incision and grafting is the preoperative maximal penile rigidity of the patient. Since this procedure is associated with a higher rate of new-onset ED, it is not recommended to be performed in PD patients with concomitant ED. Another factor that is the topic of this review is the selection of the graft/patch material. An ideal graft to patch the plaque incision in PD should have the following features (table-4).

Table-4. Features of an ideal PD graft material

• Strength and elasticity characteristics similar to tunica albuginea • Traction-resistance • Pliable, easily suturable and manipulable • Readily available • Inexpensive • Resistance to infection • Low tissue reaction and fibrosis development • Low morbidity if harvested from the patient • No interference with erectile function

It is apparent that not all of these features can be found in a single grafting material. However, to search for the holy grail of optimal PD graft, several approaches have been adopted to date. The investigators tried autografts, allografts, xenografts, and synthetic grafts in an attempt to provide as many features of an ideal graft as possible. Figure 1 shows the type of grafts that have been used so far with varying success rates.

Figure-1. Graft materials for PD



The first grafting procedure used a dermal graft and was published in 1974 (12). Since then, several different materials, biological or synthetic, have been used with mixed results. Although it was not expected that no single graft would meet all the features of an ideal graft, the lack of comparison studies made the graft selection situation more complex and less evidence-based (13). Major urological guideline bodies do not, actually can not, recommend one graft material as a preferred one over others in incision and grafting procedures (11, 14). Each graft type has some unique features supporting or limiting the use of the particular graft (Table-5).

Table-5. Unique features of grafting materials

Graft type	
Autografts	Dermal grafts are associated with veno-occlusive disease in 20%
Allografts	Cadaveric dura mater is no longer used due to concerns about spreading prion disease.
Xenografts	
Synthetic grafts	Dacron and Teflon grafts are avoided due to infection risk.

Autografts

Various tissues of the PD patient have been used to cover the incision/excision defect in the area of the maximum curvature. These include dermis, vein grafts, tunica albuginea, temporalis fascia, fascia lata, and buccal mucosa. The most commonly cited downsides of autografting are additional morbidity and time consumption while harvesting the autograft (). We will now examine each autograft material in more detail in the following part of the review.

Dermal graft

As previously mentioned above, dermal grafts were the first autografts used in PD. The last study that reported results of dermal autografting was published in 2019. De Rose and colleagues (15) reported long-term (15 years) results of autologous dermal grafting in PD patients. The study included 16 patients. Penile shortening and residual curvature were present in 40% and 25% of the patients, respectively. However, all of the patients had satisfactory penetration. In another

study (16), Chung and colleagues reported 5-year follow-up results of a mixed group of PD patients who underwent grafting surgery. In 20 out of 86 patients, a dermal graft was used. At the time of evaluation, only 5 patients could be contacted. Of these, 3 had residual curvature, and one had penile shortening. In the largest series, Austoni et al. (17) reported results of 418 PD patients with plaque excision and dermal grafting. Penile curvature relapse (17%), and erectile dysfunction (20%) were the two major complications. Since it was the first used autograft, dermal grafting studies have the largest number of patients (more than 700) among autograft materials, followed by vein grafts. When these studies were assessed together, the average success rate was 81.2%. Penile shortening was somewhat higher than expected and ranged between 45 and 70% among studies (14). This unusually high rate of ED rate following dermal grafting was attributed to veno-occlusive disease due to the lack of sufficient adaptability of dermal tissue (18). The dermal tissue was first harvested from the lower abdominal wall. Ecause of the unacceptable dermal scar after harvesting and high ED rates, dermal grafting fell from favor, and no sizable study was not performed during the last decade.

Vein graft

First introduced in 1995 (19), several studies using vein grafts with a larger number of patients relative to other autograft materials have been reported to date. Some theoretical advantages emanating from the structure of the veins promoted their widespread use. It was proposed that when grafted, the vascular endothelium of the vein graft would be in contact with the endothelium of the cavernosal tissue. Moreover, elastic and muscular tissues of the vein graft would make it possible to adapt the graft for the tissue defect of the curvature incision/excision (20). Last but not least, in patients who underwent coronary artery bypass grafting surgery, authors suggested the successful results of a new saphenous vein harvesting technique might have been due to the improved nitric oxide availability. The same also might be true for the saphenous vein grafts of Peyronie's disease patients (21). Saphenous vein graft is among the most commonly applied grafts in defect repair in lesion incision operations in PD patients.

The largest series to date have been reported in 1998 and 2005 with the same number of patients. In the former, El-Sakka and colleagues (22) operated on 113 patients using a saphenous vein graft. In 96% of the patients, a straight penis could be achieved with some residual curvatures (30 degrees in 30%). During a follow-up period of up to 18 months, only 12% reported decreased potency, while 92% were content with the overall results of the operation. In the latter study, Kalsi et al. (23) performed plaque incision and saphenous vein grafting in 113 patients. The mean duration of postoperative follow-up was 12 months. The rate of "completely" straightened penis was 93%. De novo erectile dysfunction occurred in 10% of the patients. Importantly, 51 patients could be reached after 5 years of the surgery. Among these, the penile straightness rate was reduced to 80%, whereas the ED rate increased to 22.5%. In the most recent study (24), 71 patients who had a short and bent penis that precluded intercourse, tunical incision, and saphenous graft surgery were performed. During a mean duration of 37 ± 9.4 months, "total" penis straightening was achieved in 86.8% with rates of re-curvature, de novo ED and penile shortening in 13.2%, 9.4% and 11.3%, respectively. The authors concluded that saphenous vein grafting was an effective method for PD incision surgery in the mid-long term.

European urology guidelines pooled the PD excision/incision studies using saphenous vein grafting up to 2019. Overall success rate was 85.6 (ranging between 67% 1st 100%). In one-third of all patients, there was penile shortening to some degree. It was noteworthy that the average rate of penile shortening was much lower than that of dermal grafting (32.7% vs. 59.9%) (14).

Although initially suggested as a favorable feature of saphenous vein grafts, provision of long and wide patches by saphenous vein, extensive albuginea defects might require more than one incision at the time of the harvesting of the graft (13). Some (23, 25), but not all (26), studies attributed relatively higher rates of de novo ED to the use of large vein grafts. Some saphenous vein graft studies reported postoperative ED rates of up to 50% (26, 27). It must also be kept in mind that preoperative erectile function status and the presence of risk factors for the future development of ED are important determinants of de novo ED development after PD surgery and grafting procedures.

As with all autograft procedures, saphenous vein grafting techniques are also associated with harvesting site complications. These harvesting procedures also prolong operative time. In several studies (22, 23), leg wound infection, lymphatic leakage, lymphocele, and hypoesthesia were reported each between 1 or 2% frequency.

Tunica albuginea graft

Tunica albuginea was first used by Teloken et al. as a patching material in incision procedures in the treatment of PD (28). The authors used the tissue from the crural segment of the patient's corpus cavernosa with a perineal incision. This initial experience was successful in penile strengthening in 6 out of 7 operated

patients. Then, Schwarzer and colleagues (29) shared their experience with tunica albuginea grafts. The authors harvested the graft tissue from the proximal corpora cavernosa by a horizontal infrapubic incision. Eighteen patients were included in the study. In 12 out of 16 patients had straightened penis. However, in two patients, residual curvatures below 20 degrees were seen. The overall satisfaction ratio with the results was 87.5%. The last and the largest study to date implementing tunica albuginea graft was reported by da Ros et al. (30). Thirty-three patients were followed for a mean duration of 41 months after surgery. Complete curvature correction was seen in 90% of the patients. When it is considered that the mean preoperative curvature was 91.8 degrees, the total correction rate is quite high. All patients with complete correction reported fulfilled satisfaction with the surgery. Around 18% of the patients reported new-onset ED after the procedure.

Tunica albuginea has perfect histologic characteristics to patch the incision defect of the penis. However, the maximum size that can be harvested is relatively limited. However, concerns abound regarding the weakening of penile support. Moreover, tunica albuginea graft harvesting from corpus cavernosa has the potential to make future penile prosthesis implantation more complicated (28-30).

Tunica vaginalis

Das et al. (31) first described the use of tunica vaginalis as a grafting tissue in the repair of excision defect in Peyronie's disease patients. They harvested the parietal layer of the testicular tunica vaginalis in 8 patients with PD. During a 4-16 months follow-up duration, all patients reported satisfactory intercourse. Only in one patient, mild residual curvature re-emerged. The authors did not present any data regarding erectile function of the patients after the procedure. After this preliminary experience, a few other studies replicated the procedure with varying results. O'Donnell et al. (32) recruited 25 patients. Mean follow-up duration was 42 +/- 24 months. The results revealed that only 32% of the patients were sexually active after the operation. The authors did not report the objective rates of penile straightening or residual curvature rates. However, 96% of the patients thought that their penis was shorter compared to the preoperative status, and 88% reported their satisfaction with penile straightening. A more recent study by Liu et al. (33) included 19 patients. Surgical plaques were excised, and appropriately sized tunica vaginalis was patched to the defect. The success rate in terms of penile straightening was 100%, along with no shortening or erectile dysfunction during a follow-up time of 12-43 months. The success rate and postoperative ED and penile shortening rates are not compatible with previous studies, particularly the one by Helal et al. (34).

Tunica vaginalis grafts are easy to harvest, tissue-compatible without any rejection, and can be taken just before the penile corporoplasty. It also has the advantage of concealment of resultant scar tissue occurring secondary to graft harvesting. Tunica vaginalis has a low risk of contraction thanks to its low metabolic demand (14). Lastly, in dorsal plaques, additional scrotal incision might be needed (35).

Our group performed the most recent study utilizing tunica vaginalis graft in the treatment of PD (36). In a prospective design, we recruited 20 patients with PD whose preoperative mean curvature was 48 ± 6.6 degrees. The technical success rate was 100% at 3 months and 90% at 24 months follow-up. Erectile function assessed by the International Index of Erectile Function Questionnaire (IIEF-5) improved significantly after the surgery. We also performed penile Doppler studies to show vascular changes objectively. Mean peak systolic velocity significantly increased, whereas end-diastolic velocity significantly reduced compared to preoperative values. At all follow-up points, the mean penile length was no different from the baseline.

Fascia graft

To date, fascia lata and fascia temporalis have been used as graft tissue to repair the defect during penile corporoplasty operations (37-39). First, Gelbard and coworkers described the use of fascia temporalis (37) in 12 patients. The deep temporal fascia was harvested via a post-auricular incision. All patients except one reported resumption of intercourse at 2 months postoperatively. The authors reported the maintenance of good results during a 4-22 month follow-up period. Kargi et al. (38) described the method of fascia lata grafting in 12 patients with PD. The authors harvested fascia lata from the lateral thigh. Mean postoperative follow-up duration was 10 months. The technical success rate of penile straightening was 100%. Penile shortening and de novo ED were not seen in any patients during the follow-up period. However, these perfect results could not be replicated by Kalsi et al. (39). They operated 14 patients with penile plaque incision and subsequent fascia lata patching. The penile straightening success rate was 78.6%. During a median 14 months of follow-up (17-37 months), penile shortening and de novo ED rates were 28.6% and 7.1%. The lata graft used in this study was Tutoplast®. It is a method for inactivating, preserving, and sterilizing allogenic human tissue that can be used as an allograft safely (40).

The most prominent feature of fascia, as can easily be anticipated, is their strength and mechanical

resistance. Furthermore, these grafts are considered as biologically stable (14). Despite encouraging preliminary results, the total number of patients treated with fascia grafts is still insufficient to draw conclusive recommendations.

Buccal mucosa graft

The latest advent in the autograft arena is buccal mucosa grafts. Buccal mucosa was first used in an experimental study with dogs. In a study attempting to find the best graft, Kakonashvili et al. assessed the properties of the buccal mucosa graft along with other biological tissues, including the dermis, aponeurosis, peritoneum, and vein (41). Once they decided on the best graft in terms of revascularization, adaptability, and elasticity, they proceeded to a human study (42). The authors recruited 26 patients with PD who underwent plaque excision and buccal mucosa autograft. Mean duration of follow-up was 24 +/- 1.2 months. The technical success rate of penile curvature repair was 92.3%. Four patients (15.4%) experienced shortening. Erectile function was assessed by IIEF-5 score and penile Doppler measurements. IIEF-5 scores significantly improved at all follow-up points compared to the baseline evaluation. Similarly, penile Doppler parameters were associated with significantly better vascular indices postoperatively. Only 2 patients (7.7%) reported a decrease in erection. Following the index study, several authors have evaluated buccal mucosa graft (43-46). Technical success rate varied between 87.5% and 100%. Erectile dysfunction rates remained below 10% in all studies to date. However, one study reported 80% penile shortening frequency after surgery with a buccal mucosa graft (47). However, none of the shortenings was more than 1 cm, mostly around 0.5 cm. In general, studies reported a penile shortening rate of 15.2% (14).

One of the beneficial suppositions of using buccal mucosal grafts was quick to take up thanks to the placement of the submucosa of the graft on the corpus cavernosum. Salem et al. showed lingual mucosa also serves the benefits of the buccal mucosa (45).

Recently Fabiani et al. (48) evaluated clinical outcomes in PD patients treated with penile corporoplasty with buccal mucosa grafting. They reported the results of 27 patients with a range of follow-up duration of 23-72 months. The technical success rate was 100%. Penile shortening was detected in 7.4% of patients. De novo ED was seen in 7.4% of the patients. The latest study evaluating buccal mucosa was reported by our group (49). We recruited 20 patients with PD, whose median curvature was 45 degree (ranging between 40 and 90 degrees). Technical success rate was 95% at 3-month and 90% at 24-month visits. There was no significant penile shortening. The median IIEF-5 scores were calculated as 20.1 ± 2.2 and 21.3 ± 2.2 at 3-month and 24-month visits, respectively, compared to preoperative value (17.5 ± 2.2, $p<0.0001$). There was no de novo erectile dysfunction. Ten percent of patients were poorly satisfied with the results of the surgery.

As with other autograft procedures, the main drawbacks of the buccal mucosa graft are increased operation time and local morbidity related to the graft harvesting site. However, in buccal mucosa studies, patient satisfaction rates were quite high, and no significant local complication was not observed at the graft harvesting site.

Comparative studies of autografts

Saphenous vein vs Buccal mucosa

A recent study by Danacioglu et al. (50) compared clinical outcomes of buccal mucosa and saphenous vein grafts in PD patients. All patients underwent a plaque incision; 18 took buccal mucosa, and 23 took saphenous vein grafts. Curvature characteristics, penile length, and erectile function were similar between the groups at baseline evaluation. Residual curvature rates were 13.1% and 11.2% in the saphenous vein and buccal mucosa groups, respectively. Moreover, IIEF-5 scores, penile lengths, and patient satisfaction rates were not significantly different between the groups at 6-month and 12-month follow-up points.

Tunica vaginalis vs Buccal mucosa

Our group compared the clinical and technical outcomes of the tunica vaginalis graft with the buccal mucosa graft (51). Each group included 20 patients. Baseline penile curvatures were 48.0 ± 6.6 degree in the tunica vaginalis group and 50.3 ± 11.6 degree in the buccal mucosa group ($p<0.001$). Despite this baseline curvature severity difference, at 3, 12, and 24th postoperative months, residual curvature rates were similar between the groups. The technical success rate was 90% in each group. Interestingly, in the buccal mucosa graft group, penile length increased by 11.5%. However, there was no significant difference between the groups in this respect. Baseline erectile function of the patients in each group was comparable. Baseline IIEF-5 scores significantly increased by 12% and 21.7% after surgery compared to baseline values in the tunica vaginalis and buccal mucosa groups, respectively. However, there was no difference between the groups in any of the control visits with respect to erectile function. Doppler parameters improved in both groups similarly after the surgery.

Conclusion

Which autograft to choose

As mentioned before, there are few head-to-head comparison studies utilizing autografts in the literature. As far as we know, only two studies performed a comparison of various autografts with respect to clinical outcomes and technical success. In these studies, buccal mucosa was compared against tunica vaginalis and saphenous vein. Both studies reported similar technical success rates, penile shortening rates, and postoperative de novo ED rates.

When we look at the cumulative data evaluation performed in the literature13,14, among autografts, fascia graft (temporalis and lata) had the highest technical success rates (100%), followed by buccal mucosa graft (94.1%). Penile shortening was zero with fascia grafts, followed by buccal mucosa grafts (15.2%). De novo ED rates were lowest in the buccal mucosa (0-10%) and fascia (0-7.1%) grafts. On the other hand, dermal grafts had the highest rates of de novo ED (9.1-66.7%).

Another issue that limits the evidence-based selection of the best autograft material is the small number of studies and retrospective study designs. There is no randomized controlled trial assessing the superiority of one graft over other(s) in terms of technical success and clinical outcomes. Furthermore, individual studies in a particular graft group are very heterogeneous, making it difficult to draw a general conclusion regarding that graft. For instance, the de novo ED rate is zero in some saphenous vein graft studies and as high as 50% in another saphenous vein graft study.27

Aware of the aforementioned factors, urological guideline bodies do not specifically recommend one autograft over others.11,14,52–54 In our opinion, the best approach would be the joint decision of the patient and urologist, also taking the experience of the surgeon into account. More recent and contemporary autografts such as buccal mucosa and fascia seem good choices based on the available data.

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