

# Buccal Mucosa Graft in Urological Surgery: A State-of-the-Art Review and Expert Opinion

Simone Botti <sup>1</sup>, Tommaso Ceccato <sup>1</sup>, Marco Cassaro <sup>2</sup>, Giangiacomo Sanna <sup>2</sup>, Lorenzo Trevisiol <sup>2,3</sup>  
and Tommaso Cai <sup>1,3,\*</sup>

<sup>1</sup> Urology Division, Santa Chiara Regional and Teaching Hospital, Provincial Health Care Agency (APSS), 38123 Trento, Italy; simone.botti@apss.tn.it (S.B.); tommaso.ceccato@apss.tn.it (T.C.)

<sup>2</sup> Maxillofacial Surgery Division, Santa Chiara Regional and Teaching Hospital, Provincial Health Care Agency (APSS), 38123 Trento, Italy; marco.cassaro@apss.tn.it (M.C.); giangiaco.sanna@apss.tn.it (G.S.); lorenzo.trevisiol@apss.tn.it (L.T.)

<sup>3</sup> Interdepartmental Centre of Medical Sciences (CISMed), University of Trento, 38123 Trento, Italy

\* Correspondence: ktommy@libero.it; Tel.: +39-0461-903306

## Abstract

**Background/Objectives:** Buccal mucosa graft (BMG) is increasingly utilized in reconstructive urological surgeries due to its versatility, robust integration, histological characteristics and low morbidity at the donor site. Initially employed in urethral surgery, BMG use has expanded to complex ureteral and penile reconstructive procedures. This narrative review examines BMG applications in various urological surgeries, comparing its outcomes to other graft types, with a focus on surgical techniques and patient outcomes. **Methods:** A narrative review was conducted using PubMed and Scopus to identify relevant studies published over the last three decades on the use of BMG in urological reconstructive surgery. Articles in English addressing BMG harvesting, applications and functional outcomes were analyzed. **Results:** BMG has demonstrated high success rates in every field of its application, especially in urethral reconstruction with an 83–91% efficacy rate in intermediate follow-up. Studies have also reported positive outcomes in complex ureteral and penile curvature surgeries, with patient satisfaction rates reaching up to 85%. **Conclusions:** BMG is an adaptable tissue graft for urological reconstructive surgeries, offering favorable outcomes with minimal morbidity. Although the current results are encouraging, larger prospective studies with standardized protocols are necessary to fully validate its long-term efficacy and optimize treatment approaches for complex urological reconstructions.

**Keywords:** buccal mucosa graft; urethroplasty; ureteroplasty; penile curvature surgery; Peyronie's disease; oral mucosa graft; periodontal graft; mucosal graft



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## 1. Introduction

In reconstructive urological surgery there are different cases in which the use of a graft is needed. A graft is a piece of tissue taken from a part of the body or from a synthetic or engineered source and transplanted to a different area to repair or reconstruct. The first challenge in this kind of surgery is a functional/oncological one, depending on why the surgery is performed, and the second is related to morbidity at the explantation site. At the moment, tissue engineering in reconstructive urology is in its early stages but has great potential [1]. However, the use of autologous graft is widely accepted, and different types of grafts have been investigated in the past few decades (fasci lata graft, skin graft, intestinal graft, bladder mucosa graft, penile/preputial skin graft, etc.). Among

these, the buccal mucosa graft (BMG) seems to have many characteristics that make it the preferred graft to use [2–9] with a high success rate and integration potential. The BMG is in fact flexible, robust, resistant to infection and cost-effective; does not promote inflammatory reaction; does not contract; and has histological properties that make it a perfect choice for a moist environment. Moreover, it is linked to a low rate of explantation site morbidity. The buccal mucosa graft (BMG) is a type of oral mucosa graft (OMG). This also includes the less commonly used lingual mucosa graft (LMG). The BMG in the urology field was created for urethral surgery. Its use was first described in 1890 by Sapezhko [3] for the treatment of idiopathic urethral stenosis. Subsequently, the BMG was used in 1941 by Humby [4] in a child who had already undergone multiple hypospadias surgeries, resulting in a penoscrotal fistula, and then its use was repurposed in 1992 by Burger et al. [5] and Dessanti et al. [6] for complicated urethral surgeries. Nowadays, AUA and EAU guidelines recommend the use of BMG in particular for complex urethral reconstruction [7,8].

The use of BMG is not only related to the reconstruction of the lower urinary tract; in fact in 1999, for the first time, Naude [10] described his experience with six patients with complicated ureteric stricture and segmental ureteric loss treated with a buccal mucosa graft with good functional results. Nowadays, its use for complex ureteral reconstructive surgery is considered a good option, even if a tailored approach is suggested [11].

Another important field in which the BMG appears to play a major role is Peyronie's disease surgery in which it seems to have the best functional and esthetic outcomes [12]. Here, we aim to give a brief review of the use of buccal mucosa graft in urological and andrological surgery in order to provide the readers with some suggestions for use in everyday clinical practice, on the basis of recent evidence.

## 2. Materials and Methods

### 2.1. Research Strategy

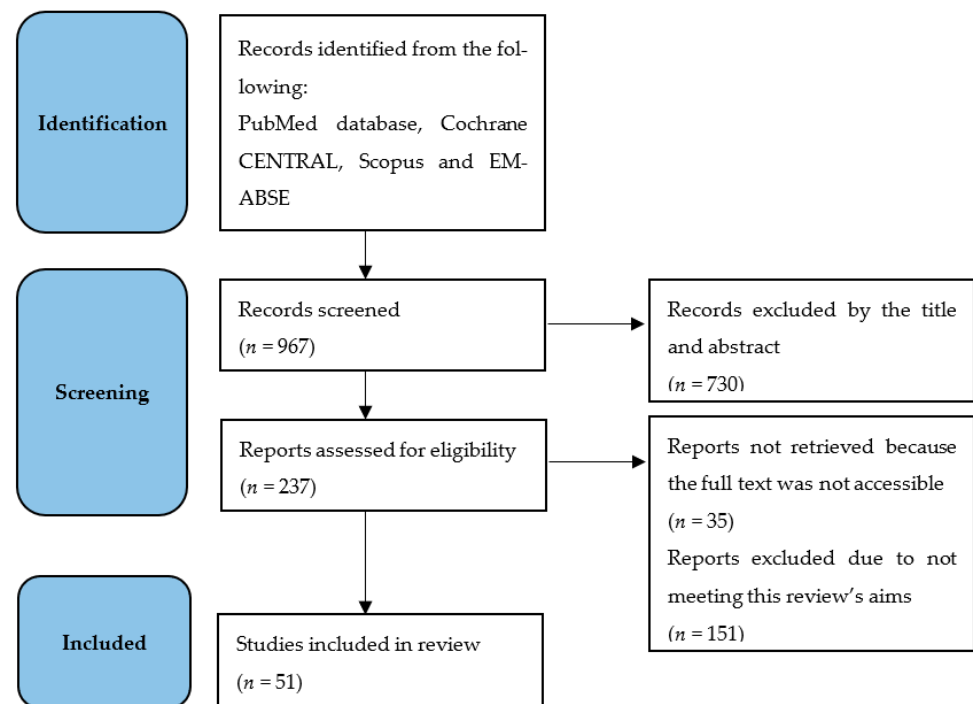
From 16 September 2024 to 30 January 2025, two independent reviewers (S.B. and T.C. (Tommaso Ceccato)) performed this research on the PubMed database, Cochrane CENTRAL, Scopus and EMBASE. All references cited in relevant articles were also reviewed and analyzed. This narrative review aims to create an overview of the use of buccal mucosa graft in uro-andrology reconstructive surgery, focusing on the technical aspect of graft harvesting, its different uses in various urological fields and its functional outcomes. The keywords used were "buccal mucosa graft AND urology", "buccal mucosa graft AND urethroplasty", "buccal mucosa graft AND ureteroplasty", "buccal mucosa graft AND penile curvature", "oral mucosa graft AND urethroplasty", "oral mucosa graft AND ureteroplasty" and "oral mucosa graft AND penile curvature".

### 2.2. Inclusion and Exclusion Criteria

All cross-sectional, case-control, prospective and retrospective studies, RCTs and reviews were included. Any disagreements between the two reviewers were resolved by consulting the supervisors (T.C. (Tommaso Cai) and L.T.). The following filters were used in the present research: clinical trial, humans, English language and adult. The first selection of studies was performed using abstracts and titles. The reviewers conducted a full-text analysis in cases where the abstract evaluation was insufficient to determine whether the study satisfied inclusion or exclusion criteria.

Given the breadth of literature available on the topic as a whole and on each specific active substance, the authors deemed it appropriate to present the findings of this review in a narrative format. A systematic or meta-analytical comparison of such diverse outcomes in terms of measurement, population and methodology falls outside the scope of this

work; however, this review was performed in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Figure 1).



**Figure 1.** This flow chart shows the outcome of the literature search, screening and inclusion in line with the PRISMA statement.

### 3. Research Evidence

#### 3.1. Buccal Mucosa Graft: The Surgical Procedure

After nasotracheal intubation, the buccal mucosa is exposed, positioning a bite block between the dental arches contralateral to the graft site and retracting the tongue away from the donor site. The anatomical landmarks are then identified. These are represented by the labial commissure and the orifice of the Stensen duct. The mucosal graft limits are drawn with a dermatographic pen. It is important to maintain a distance of at least 1 cm from the two anatomical landmarks previously described to avoid complications at the donor site. First, the buccal mucosal area is infiltrated with local anesthesia with a vasoconstrictor. A mucosal and submucosal incision is then performed with a 15-blade scalpel. We proceed with dissection beneath the submucosal plane which must be separated from the underlying buccinator muscle anteriorly and from the retromolar trigone posteriorly. Bipolar cautery at 10 W is used to obtain hemostasis. For small defects, it is usually possible to proceed with primary closure of the donor site by the juxtaposition of the mucosal margins and suture with absorbable 4/0. For larger defects, a second intention healing is preferred. In this case, it could be useful to cover the remaining defect with fat gauze held in place by absorbable stitches. The fat gauze has to be removed after 10 days. An excellent alternative is represented by a sponge sealant patch made by fibrinogen and thrombin, etc., which do not need to be removed. Other types of membranes are described in the literature with interesting results that may represent excellent alternatives in the future for gingival and oral mucosa regeneration [13]. This surgery procedure can be repeated in the same surgical session on the oral mucosa of the opposite site if larger grafts are needed [14]. The patient should be on a soft and cold diet for the first 3–4 days after surgery and then on a soft and warm diet for another 10 days. Chlorhexidine mouthwash rinses should be executed after each meal for two weeks after surgery. It is necessary to encourage the patient, from the

first few days after surgery, to perform exercises for mouth opening and mimics to avoid healing with excess fibrosis or lockjaw.

### 3.2. Buccal Mucosa Graft: Characteristics

Using this technique, a large graft can be obtained from the buccal mucosa of both sides. The extension of the graft should have a maximum diameter of 40–45 mm to avoid lesions of the aforementioned anatomical landmarks. The mucosal graft should be longer than the defect it aims to repair because it has a tendency to contract itself over time [15].

### 3.3. Buccal Mucosa Graft: Donor Site Complications

Ten days after surgery, the surgical site is generally healed in the case of primary closure, while larger defects are left to heal by secondary intention with a fat gauze as a cover, as previously explained. In this case, complete healing will usually occur within 15–20 days, barring complications. The main complications are pain, swelling, bleeding and infections of the donor site [16]. In particular, about 58% of patients needed analgesia for oral pain, and 24% reported several difficulties to eat and to drink (“impossible/very difficult”) [17]. The lingual mucosa graft showed a higher prevalence of donor site complications in terms of difficulties to eat and drink (resp. 62.1% versus 24.1%;  $p = 0.004$ ) [17]. Moreover, lingual mucosa graft was associated with more speech impairment (93.1% versus 55.2%) and dysgeusia (48.3% versus 13.8%) as compared to BMG [17]. Other possible complications are lip intrusion if the safety distance from the labial commissure has not been respected, gingival recession if the attached mucosa has been incised and sialoceles if the Stensen duct has been interrupted or damaged. An extremely rare complication is oral submucosal fibrosis secondary to graft harvesting [18]. Late complications are reported in a small proportion of patients: problems with drinking (1.7%), eating soft or solid food (3.4%), dysgeusia (5.2%), salivatory changes (10.3%) and speech impairment (15.5%) [17].

### 3.4. Tips and Tricks

- Not all patients are candidates for oral mucosal harvesting. The selection of patients is the most important part of the flow chart presented above. An accurate medical history must be obtained to eliminate patients who are heavy smokers or have a history of alcohol abuse, a diagnosis of oral lichen planus, etc. An accurate objective examination of the oral cavity must exclude the presence of dental or mucosal pathologies (oral lichen planus, leuko/erythroplakia, dysplasia, carcinomas, etc.) in the harvesting sites. These clinical conditions can lead to the malignant transformation of the oral mucosa [19].
- To reduce the risk of infection of the donor site, it is useful to perform professional oral hygiene treatment a few days before the surgical procedure [20].
- Nasotracheal intubation is recommended to facilitate the harvesting procedure, especially in bilateral sampling.
- It is important to respect and maintain a safe distance from anatomical landmarks: the labial commissure, Stensen duct orifice and attached gingiva.
- The infiltration of the donor site with local anesthesia with a vasoconstrictor allows for the hydro-dissection of the mucosa from the underlying layers, making graft harvesting easier. The vasoconstrictor prevents excessive bleeding, allowing for an easier surgical procedure.
- It is mandatory to identify wide safety margins from the described anatomical landmarks; these can be marked with a dermatographic pen, or for example, the Stensen duct can be cannulated with a lacrimal probe.

### 3.5. Urethroplasty: Techniques and Functional Results

As we mentioned, buccal mucosa grafts have become a widely accepted approach in urethroplasty for reconstructing urethral strictures. This technique is particularly valuable when primary surgical methods have proven unsuccessful or local tissue supply is insufficient or in cases of long-segment (>2 cm) and recurrent strictures [7,8]. Over the years, numerous urethroplasty techniques utilizing buccal mucosa grafts have been developed, highlighting their exceptional versatility—a fundamental attribute given the considerable variability in urethral strictures and their prior treatments. In discussing urethroplasty with BMG, several distinct types of techniques can be identified: dorsal onlay graft, ventral onlay graft, lateral onlay graft, dorsal inlay graft, dorsal inlay and ventral onlay graft. In the dorsal onlay approach, described first by Barbagli et al. in 1996, following the incision of the stricture, a BMG is positioned on the dorsal aspect of the urethra, where it benefits from the robust vascular support provided by the spongiosum tissue [21,22]. In the ventral onlay approach, a BMG is placed on the ventral side of the urethra, offering easier access and a less complicated surgical technique, at the expense of reduced physical and vascular support [23]. The lateral onlay approach was described by Barbagli et al. [24] in cases where ventral urethrotomy carries a risk of significant bleeding, and dorsal urethrotomy may compromise erectile function due to the proximal dissection of the urethra from the corpora cavernosa. On the other hand, in the inlay dorsal approach, a graft is placed on the dorsal side of the urethra within the lumen, rather than on top of the urethra as in the dorsal onlay approach [25–28]. All the different techniques can be performed at one time or at multiple times. The two-stage technique is specifically employed in cases involving extensive segments of spongiofibrosis, penile strictures, previous hypospadias repair affecting the penile urethra or the presence of insufficient subcutaneous tissue coverage [29]. The second stage of the procedure is usually performed 4–6 months later, to allow the tissues to heal properly. In terms of outcomes, all types of BMG urethroplasty have a similar success rate of 83–91% in the intermediate follow-up, and the two-stage approach seems to be better even if there is a lack of strong evidence [29–42]. Nevertheless, in their meta-analysis considering all types of urethroplasty augmentation, Benson et al. suggested that this rate will decrease in a longer follow-up of 15 years to 45–63% [43]. Recently, BMG urethroplasty has been proven to be as effective as the end-to-end technique, in particular in the treatment of bulbar stricture, with no differences in terms of stricture recurrence and voiding symptoms but with a lower rate of penile complication and erection dysfunction [24,30,32,34,44]. In fact, the transecting excision and primary anastomosis (tEPA) appears to have a greater impact on penile length and glans filling precisely due to the interruption of the neurovascular structures [31,32]. Table 1 summarizes all relevant included clinical trials in this subsection of this review.

**Table 1.** This table shows a summary of all relevant included clinical trials.

Author	Year	Type of Study	Aim	Description of Findings
Barbagli, G. [21]	1998	Prospective study	To report the outcome and functional results of a 1-stage correction of bulbar urethral stricture using a penile skin or buccal mucosa graft	Onlay graft urethroplasty provided excellent results in 92% of adults with bulbourethral stricture
Barbagli, G. [22]	1996	Prospective study	To evaluate the outcome and functional results of dorsal free graft urethroplasty	The use of free skin grafts for urethral reconstruction is anatomically healthier in the dorsal than in the ventral position

Table 1. Cont.

Author	Year	Type of Study	Aim	Description of Findings
Barbagli, G. [24]	2005	Comparative study	To compare the outcome of 3 types of bulbar urethroplasty using buccal mucosa graft	BMG into the ventral; the dorsal or lateral surface of the bulbar urethra showed the same success rates (83% to 85%)
Gupta, N.P. et al. [26]	2004	Prospective study	To present the technique of dorsal buccal mucosal graft urethroplasty through a ventral sagittal urethrotomy and minimal access perineal approach for anterior urethral stricture	Dorsal buccal mucosal graft urethroplasty via a minimal access perineal approach is a simple technique with a good surgical outcome
Asopa, H.S. et al. [27]	2001	Prospective study	To present the technique of applying a dorsal free graft to treat urethral stricture by the ventral sagittal urethrotomy approach without mobilizing the urethra	The ventral sagittal urethrotomy approach for dorsal free graft urethroplasty is not only feasible and successful but is also easy to perform
Palminteri, E. et al. [28]	2008	Prospective study	To describe a new technique for bulbar urethral reconstruction using a combined dorsal plus ventral double BMG	The double dorsal and ventral graft may provide a simple and reliable solution to achieve an adequate urethral lumen in selected patients
Nilsen, O.J. et al. [31]	2022	RCT	To evaluate sexual dysfunction and penile complications after urethroplasty with transecting excision and primary anastomosis versus BMG	Penile problems are more common after the transection technique than after the grafting technique
Anderson, K.M. et al. [34]	2017	Retrospective comparative study	To review the long-term outcomes of transecting versus non-transecting urethroplasty to repair bulbar urethral strictures	Transecting and non-transecting primary bulbar urethroplasty resulted in a similar long-term stricture resolution rate
Lumen, N. et al. [17]	2016	Comparative study	To compare BMG and lingual mucosa graft urethroplasty with respect to donor site morbidity and urethroplasty outcome	The success of urethroplasty with lingual and buccal mucosa grafts was similar
Simonato, A. et al. [42]	2006	Prospective study	To evaluate the outcome and functional results of lingual mucosal graft for urethroplasty	Harvesting the lingual mucosal graft is feasible and easy to perform

### 3.6. Ureteroplasty: Techniques and Functional Results

Following the undoubtedly greater experience in urethral surgery, the BMG has also started to be used in the challenging field of ureteral reconstruction [11]. Specifically, it has been used as an option in the management of complex proximal stenosis and in middle ureteric stricture, serving as an alternative to the use of appendiceal flap, ileal replacement or renal auto-transplantation. The choice of BMG surgical technique depends on the considerable variability in stricture characteristics and prior treatments; however, the most commonly performed techniques are ventral onlay ureteroplasty and augmented anastomotic ureteroplasty with a conclusive omental or perinephric fat wrapping [44–46]. In a recent meta-analysis comparing OMG ureteroplasty with ileal replacement, You et al. found a similar success rate (94.9% vs. 85.8%) and lower complication rate for OMG surgery, but these data should be interpreted considering the shorter follow-up period and the shorter strictures treated with BMG [44]. Ileal replacement remains, at the moment, the strategy of choice in strictures >8 cm, in bilateral stenosis and in radiated patients. Augmentation ureteroplasty can also be performed with other types of grafts. In 2006,

Simonato et al. described for the first time the use of lingual mucosa graft [42], which has a similar success rate to BMG but is associated with more frequent speaking and drinking problems in the postoperative period [37–39]. Other commonly used grafts are penile skin and preputial grafts, which seem to have a lower success rate than BMG and come with more complications [40,41]. Other reported grafts are tunica vaginalis, bladder mucosa, colonic mucosa and saphenous vein grafts. There is a very low amount of data on all of these grafts, which limits their routine use. In conclusion, we have to consider that it is challenging to attain definitive results, as most studies are retrospective and exhibit substantial variability in surgical techniques, surgeon experience, stricture characteristics and previous treatment, follow-up protocols and the definitions of outcomes. Ultimately, BMG also seems to be used safely for female urethral stricture, but the data available are limited [47]. Table 2 summarizes all relevant included studies in this subsection of this review.

**Table 2.** This table shows a summary of all relevant included meta-analyses and clinical trials.

Author	Year	Type of Study	Aim	Description of Findings
You, Y. et al. [44]	2023	Systematic Review and Meta-Analysis	To compare the outcomes of oral mucosal graft ureteroplasty and ileal ureter replacement	Oral mucosal graft ureteroplasty is an effective, minimally invasive and safe procedure. Oral mucosal graft ureteroplasty should be the preferred treatment for long ureteric strictures, especially obstructed ureter segments of $\leq 8$ cm
Wang, J. et al. [45]	2021	Prospective Study	To present the “omental wrapping” technique in laparoscopic and robotic ureteroplasty using onlay flaps or grafts for the management of long proximal or middle ureteral strictures	This procedure is an efficient, safe, reproducible and simple technique
Jiang, Y. et al. [47]	2024	Prospective Study	To evaluate the effectiveness of the “perinephric fat wrapping” technique in laparoscopic ureteroplasty with oral mucosal graft	This technique is safe and effective in repairing and reconstructing the ureter using oral mucosal grafts

### 3.7. Ureteroplasty: Laparoscopic Robotic-Assisted Surgery

One of the mainstays of robotic ureteral restoration is robotic buccal mucosa graft ureteroplasty (RU-BMG). This technique is a flexible and feasible surgical procedure for treating long-segment strictures of the ureteropelvic junction, proximal ureter or mid-ureter when performing a tension-free ureteroureterostomy could be challenging [48]. Patients with significant peri-ureteral scarring and obliteration of normal dissection planes who have had unsuccessful ureteroplasty may also benefit from RU-BMG. The flexibility and feasibility of RU-BMG are due also to the fact that compared to conventional methods, RU-BMG frequently requires a less thorough ureterolysis, which reduces the amount of ureteral vascular disruption during the recovery phase [48]. The first series of RU-BMG was described by Zhao et al. in 2015 [49], demonstrating 100% clinical success in four patients treated with the robotic-assisted reconstruction of the ureter using buccal mucosa graft [49]. Recently, Sahay et al. reported their experience with 16 cases of BMG ureteroplasty, which were performed both laparoscopically and robotically, showing that RU-BMG

provides the benefits of improved ergonomics, easy maneuverability and precision surgery to patients [50]. The series of RU-BMG reported by Yang et al. proved the effectiveness of robotic-assisted ureteroplasty with BMG onlay in reconstructing the proximal and middle ureters' long-segment stricture [51]. Finally, You Y. et al. conducted a meta-analysis and systematic review to compare the functional and clinical results of ileal ureter replacement and RU-BMG [44]. According to their analysis of 23 trials, RU-BMG is a safe, minimally invasive and effective treatment for lengthy ureteric strictures, particularly when ureter segments of less than 8 cm are obstructed [44]. In conclusion, the buccal mucosa graft ureteroplasty performed by using laparoscopic robotic-assisted surgery should be considered the gold standard treatment of long-segment strictures of the ureteropelvic junction, proximal ureter or mid-ureter. Table 3 summarizes all relevant included studies in this subsection of this review.

**Table 3.** This table shows a summary of all relevant included meta-analyses and clinical trials in this subsection.

Author	Year	Type of Study	Aim	Description of Findings
Chao, B.W. et al. [48]	2025	Review (tips and tricks)	To give the readers an overview of the current experiences related to the use of the buccal mucosa graft ureteroplasty performed by using laparoscopic robotic-assisted surgery.	Robotic ureteroplasty by using BMG showed a high rate of clinical success with comparatively minimal morbidity and excellent success rates.
Zhao, L.C. et al. [49]	2015	Prospective study	To describe RU-BMG as a minimally invasive ureteral reconstruction technique for ureteral strictures.	This procedure is a flexible and feasible surgical procedure for treating long-segment strictures of the ureteropelvic junction, proximal ureter or mid-ureter.
Sahay, S.C. et al. [50]	2024	Prospective study	To present the functional outcome of 16 cases of BMG ureteroplasty performed by the laparoscopic and robotic approaches.	RU-BMG provides the benefits of improved ergonomics, easy maneuverability and precision surgery to patients.
You, Y. et al. [44]	2023	Systematic review and meta-analysis	To describe the outcomes of oral mucosal graft ureteroplasty and ileal ureter replacement and determine the relative merits of both procedures.	RU-BMG is an effective, minimally invasive and safe alternative to ileal ureter replacement for the management of long ureteric strictures.

### 3.8. Penile Curvature Surgery: Techniques and Functional Results

The BMG can also be used in straightening penile surgery in the second/chronic stage of Peyronie's disease (Induratio Penis Plastica) (IPP), when the fibrotic plaque is stable and asymptomatic for at least six to twelve months [52]. In particular, at this point in the course of the disease, for a patient with penile deformity and severe stable penile curvature, erection dysfunction (ED) or penile loss of length, after a comprehensive counseling session examining the advantages and disadvantages, corrective surgery can be proposed to the patient. Over the years, numerous surgical techniques have been developed, including tunica albuginea plication (shortening procedures of the convex part), plaque incision/plaque excision and grafting (lengthening procedures) and the possible contextual insertion of a penile prosthesis in a patient with prior ED [53]. Lengthening procedures are specifically indicated for a penile curvature of more than 60° or when a shortening technique would result in a reduction of more than 20% of the total penile length [54]. In these procedures, after degloving the penis without performing a circumcision unless

the foreskin is phimotic [54], the surgeon has to assess the curvature of the penis and isolate the dorsal neurovascular bundle. Subsequently a relaxing incision/partial excision of the plaque on the maximum concave part of the curvature has to be performed. At the moment, no incision procedure has been proven to be surely superior to the other, with the modified H- or double Y-incision being the most commonly used nonetheless, but the complete excision of the plaque is now an abandoned practice due to its increased possibility of DE [55–57]. When we consider the use of a graft to fulfill the tunica albuginea defect in IPP surgery, we can choose among an autologous graft (vein, dermis, tunica vaginalis, tunica albuginea, buccal mucosa, lingual mucosa, fascia lata) or non-autologous graft (allograft: human dermis, human pericardium, human fascia lata, human dura mater, human amniotic membrane; xenograft: bovine pericardium, porcine small intestinal submucosa, porcine dermis, equine collagen fleece). Synthetic grafts are no longer an option because of their collateral effect and antigenicity [57,58]. All grafts have pros and cons with none being absolutely superior, and their use has to be tailored to the patient's will, the disease characteristics and the surgeon's experience [52,56]. In this kind of surgery, non-autologous grafts are generally more popular because of their lower morbidity and the minor operative time needed, but the few experiences with BMG are promising. In a small series of 32 patients, Zucchi et al. [59] described a high patient satisfaction rate (85%), a low incidence of DE (4%) and a high rate of penile straightening (96%) in patients who underwent BMG IPP surgery. Similar results were reached before by Shioshvili et al. in 2005 [60] and by Cormio et al. in 2009 [61] and have been confirmed by a recent meta-analysis that describes the BMG as the best-performing graft [12]. In a recent small series, the LMG also showed promising results [62]. Table 4 summarizes all relevant included studies in this subsection of this review.

**Table 4.** This table shows a summary of all relevant included position statements, reviews and clinical trials.

Author	Year	Type of Study	Aim	Description of Findings
Osmonov, D. et al. [53]	2022	Scientific Society Position Statement	To review the evidence associated with the surgical treatment of Peyronie's disease and provide clinical recommendations on behalf of the European Society for Sexual Medicine	Patient preoperative counseling is recommended in order to increase patients' satisfaction. Surgical treatment should only be offered in the chronic phase of the condition
Garaffa, G. et al. [54]	2010	Comparative Study	To assess the outcome of not circumcising patients who have surgery to correct a congenital or acquired curvature	Circumcision should not be considered a routine part of penile surgery unless a significant phimosis is present or revisional surgery is contemplated
Hatzichristodoulou, G. et al. [57]	2024	Review	To provide an overview of recent studies reporting the outcomes of grafting techniques and to report advances in the development of new grafting materials for Peyronie's disease surgery	Surgeon experience, careful patient selection, patient preference and the type of penile deformity affect the use of BMG and the surgical approach used

Table 4. Cont.

Author	Year	Type of Study	Aim	Description of Findings
Zucchi, A. et al. [59]	2015	Prospective Study	To assesses the surgical and functional efficacy of corporoplasty with buccal mucosa graft, patients' and their partners' satisfaction and the low cost of this operation	Corporoplasty with buccal mucosa graft is easy to perform and represents a good treatment choice for most forms of Peyronie's disease with curvature preventing penetration and sexual intercourse
Shioshvili, T.J. et al. [60]	2005	Comparative Study	To evaluate the clinical results of the use of buccal mucosa for the replacement of Peyronie's disease plaque	BMG showed good properties of adaptation and revascularization and good anatomical and functional clinical results
Cormio, L. et al. [61]	2009	Multicenter Study	To evaluate the efficacy, safety and reproducibility of plaque incision and BMG in patients affected by Peyronie's disease	BMG provided excellent short-term results with the fast return of spontaneous erections and prevented shrinkage

### 3.9. Hypospadias Surgery in Adults: The Role of Buccal Mucosa Graft

BMG is, today, recognized as the standard of care in the reconstruction of penoscrotal hypospadias with very good results in terms of functional outcome and patients' satisfaction [63]. Twelve years is the average age of people who have had hypospadias surgically repaired [63,64]. Even though the number of adults who go untreated has been declining in recent years, the functional outcomes and patient outcomes of surgically correcting hypospadias are excellent. At a mean 28-month follow-up, Zhao et al. showed that buccal mucosa graft as a tube is a reliable and long-lasting method of two-stage repair for severe and complex adult hypospadias, reporting very good results in terms of outcomes [65]. According to Sahin et al., buccal mucosa is a feasible and reliable graft in challenging situations as well, such as adults who have had multiple surgeries or who are circumcised [66].

### 3.10. Complications and Preventing Strategies for Reducing Complications

Several complications after BMG are described in the literature, particularly in relation to graft rejection and surgical site infections [67]. Surgical site infection is one of the most described complications affecting the functional results. Recently Pogorelić et al. reported the results of a study comparing the safety and efficacy of triclosan-coated PDS Plus sutures versus uncoated PDS II sutures for the prevention of SSIs after hypospadias repair [67]. They demonstrated that the use of PDS Plus in hypospadias surgery significantly reduces the incidence of SSI, postoperative fistulas and reoperation rates compared to PDS II [67]. In this sense, the use of a specific suture should be considered in patients at high risk of surgical site infection. New technologies and materials have been recently developed with the aim of repairing and reconstructing the lost tissue with promising results [68]. However, future studies comparing new technologies and materials with BMG are needed before introducing these new techniques into everyday clinical practice [68].

### 3.11. The Use of BMG in Pediatric Surgery

BMG is most frequently used in pediatric surgery to treat hypospadias and urethral and ureteral strictures. It is crucial to draw attention to certain elements, even if the surgical techniques are fairly comparable to those used on adults. Recently, Han et al. reported their experience with 15 pediatric and adolescent patients who underwent robot-

assisted ureteroplasty with BMG, showing that BMG appears to be safe and feasible for repairing long ureteral strictures in the pediatric setting [69]. The use of robotic surgery for BMG should be considered as the usual practice, just like in the adult setting. Regarding ureteroplasty, there are some aspects to highlight in pediatric surgery. Firstly, concerns exist that the neourethra might not develop in proportion to the phallus [70]. In a cohort of 137 boys who underwent staged BMGU before the age of 12 years, Figueroa et al. demonstrated that buccal mucosa grafts appear to grow proportionally to the phallus after pubertal endogenous androgen stimulation [70]. Regarding the donor site, Elifranji et al. reported their experience with the use of upper lip graft for urethral augmentation in the pediatric setting [71]. They showed that upper lip graft is safe and easy to obtain with a limited complication rate, even if it provides a limited amount of tissue for urethral augmentation; therefore it is not an option for long urethroplasties [71]. Next, regarding hypospadias repair, an interesting issue is the use of BMG in adult patients with a history of hypospadias repair who required subsequent urethroplasty. In 2018, Morrison et al. reported their experience with 32 patients [72]. They showed that very good outcomes can be achieved using a 2-stage approach with the replacement or augmentation of the urethral plate in adults with failed hypospadias repair [72]. Finally, Djordjevic et al. reported a novel and 1-stage technique of using a specially shaped buccal mucosa graft for simultaneous ventral tunica grafting and urethroplasty for severe hypospadias repair [73], showing that this technique is a viable and reliable option for the single-stage repair of scrotal hypospadias with severe chordee [73]. The role of BMG in pediatric surgery increased in recent years, showing excellent functional and clinical outcomes. Table 5 summarizes all relevant included studies in this subsection of this review.

**Table 5.** This table shows a summary of all relevant included clinical trials.

Author	Year	Type of Study	Aim	Description of Findings
Han, C. et al. [69]	2024	Prospective study	To evaluate the functional outcomes of robot-assisted ureteroplasty with BMG for long proximal ureteral stenosis in children and adolescents.	BMG appears to be safe and feasible for repairing long ureteral strictures in pediatric and adolescent patients.
Figueroa, V. et al. [70]	2014	Prospective study	To report the data for post-pubertal follow-up after pre-pubertal BMG urethroplasties.	Buccal mucosa grafts appear to grow proportionally to the phallus after pubertal endogenous androgen stimulation.
Elifranji, M. et al. [71]	2020	Prospective study	To evaluate the functional outcomes of the use of upper lip graft in urethroplasty.	Upper lip graft harvest is easy and a suitable alternative source of oral mucosa for urethroplasty in children.
Djordjevic, M. et al. [73]	2020	Prospective study	To present a novel and 1-stage technique in scrotal hypospadias repair.	A “watch”-shaped buccal mucosa graft for simultaneous curvature correction and urethroplasty is a viable and reliable option for the single-stage repair of scrotal hypospadias with severe chordee.

#### 4. Novel Applications

Due to its characteristics, BMG has also found experimental applications in other types of reconstructive surgeries, for which data are still extremely limited. One of the most

promising fields seems to be its use in the treatment of refractory bladder neck contraction, first described by Avalone et al., whose results were later confirmed by Bozkurt et al. [74,75].

## 5. Conclusions and Future Perspective

Urological reconstructive surgery is a complex field in which each intervention must consider patient expectations, disease characteristics, graft/flap properties and the surgeon's expertise to provide a tailored solution for each patient. In this context, the BMG is surely a versatile, efficient and cost-effective tissue that can safely be used in different urological reconstructive surgeries with a high rate of success in terms of functional outcomes. Its promising results have been observed in multiple applications, from urethral surgery to penile curvature surgery passing through ureteral reconstruction, but larger, prospective studies with standardized protocols are necessary to fully validate its long-term efficacy and optimize patient outcomes.

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## Abbreviations

The following abbreviations are used in this manuscript:

BMG	Buccal mucosa graft
OMG	Oral mucosa graft
LMG	Lingual mucosa graft
tEPA	Transecting excision and primary anastomosis
ED	Erection dysfunction

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