

Review

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Review

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

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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 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

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 done, the second is related to the morbidity at the explantation site. At the moment, tissue engineering in reconstructive urology is in its early stages, but has great potential [1]. On the other hand, the use of autologous graft is widely accepted and different types of grafts have been investigated during the 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 made it a preferred graft to engage [2–9] with high success rate and integration potential. The BMG is in fact flexible, robust, resistance to infection, 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 urology field was born for urethral surgery. Its use was at 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 underwent multiple hypospadias surgeries resulting in a peno-scrotal fistula and then its use has been repurposed in 1992 by Burger et al. [5] and Dessanti et al. [6] for complicated urethral surgeries. Nowadays, AUA and EAU guidelines recommended 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 6 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 the Peyronie's disease surgery in which it seemed to have the best functional and aesthetic outcomes [12].

2. Materials and Methods

2.1. Research Strategy

From September 2024 to January 2025, two independent reviewers performed the research in PubMed database, Cochrane CENTRAL and Scopus. Any disagreements between the two reviewers were resolved by consulting a supervisor. All references cited in relevant articles were also reviewed and analyzed. This narrative review aims to make an overview in the use of buccal mucosa graft in uro-andrology reconstructive surgery, focusing on the technical aspect of graft harvesting, its different use in various urological fields and focusing on 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", "oral mucosa graft AND penile curvature". As filters, we used: clinical trial, humans, English language, and adult. 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 has been performed in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).

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 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 was used to obtain hemostasis. For small defects, it is usually possible to proceed with primary closure of the donor site by 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 sponge sealant patch made by fibrinogen and thrombin, etc. which do not need to be removed. Other types of

membranes are described in 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: The Characteristic

Using this technique, a large graft can be obtained from 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 the tendency to contract itself over time [15].

3.3. Buccal Mucosa Graft: Outcome

Ten days after surgery, the surgical site is generally healed in 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, a 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]. 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 [17].

3.4. Tips and Tricks

- Not all patients are candidates for oral mucosal harvesting. Patients selection is the most important part of the flow chart. An accurate medical history must be carried out to eliminate patients who are heavy smokers or with a history of alcohol abuse, with 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 malignant transformation of the oral mucosa [18].
- To reduce the risk of infection of the donor site, it is useful to perform professional oral hygiene a few days before the surgical procedure [19].
- Nasotracheal intubation is recommended to facilitate the harvesting procedure, especially in bilateral sampling.
- Respect and maintain a safe distance from anatomical landmarks: labial commissure, Stensen duct orifice and attached gingiva.
- Infiltration of the donor site with local anesthesia with vasoconstrictor allows hydro dissection of the mucosa from the underlying layers, making graft harvesting easier. The vasoconstrictor prevents excessive bleeding, allowing 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, Stensen duct can be cannulated with a lacrimal probe.

3.5. Uretroplasty: Techniques and Functional Results

As we have already said, 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, local tissue supply is insufficient, or in cases of

long-segment (> 2cm) and recurrent strictures [7,8]. Over the years, numerous urethroplasty techniques utilizing buccal mucosa grafts have been developed, highlighting its 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 on lay graft, ventral on lay graft, lateral on lay graft, dorsal inlay graft, dorsal inlay and ventral on lay graft. In the dorsal on lay approach, described at first by Barbagli et al in 1996, following incision of the stricture, an BMG is positioned on the dorsal aspect of the urethra, where it benefits from robust vascular support provided by the spongiosum tissue [20,21]. In the ventral on lay approach an 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 [22]. The lateral on lay approach was described by Barbagli et al. [23] 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 on lay approach [25–27]. All the different techniques can be performed in one time or in 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 and the presence of insufficient subcutaneous tissue coverage [28]. The second stage procedure is usually done 4–6 month later, to allow the tissues to heal properly. In terms of outcomes, all type of BMG urethroplasty have a similar success rate of 83–91% in the intermediate follow up and the two-stage approach seem to go better even if there is lack of strong evidences [28–41]. Nevertheless, Benson et al in their meta-analysis considering all types of urethroplasty augmentation, have suggested that these results will decrease in a longer follow up of 15-year till 45%–63% [42,43]. Recently, BMG urethroplasty has been proved to be as effective as end-to-end technique, in particular in the treatment of bulbar stricture, with no differences in term of stricture recurrence and voiding symptoms, but lower rate of penile complication and erection disfunction [23,29,31,33]. In fact, the transecting excision and primary anastomosis (tEPA) appears to have a greater impact on penile length and glans filling precisely due to an interruption of the neurovascular structures [30,31].

3.6. Ureteroplasty: Techniques and Functional Results

Following the undoubtedly greater experience in urethral surgery, the BMG has started to be used also 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 urethric 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 technique are the ventral on lay ureteroplasty and the augmented anastomotic urethroplasty with a conclusive omental or perinephric fat wrapping [43–46]. In a recent meta-analysis comparing OMG uteteroplasty with ileal replacement, You et al. found a similar success rate (94,9% vs 85.8%) and lower complication 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 stricture >8 cm, in bilateral stenosis and in radiated patient. Augmentation urethroplasty can be also performed with other types of grafts. In 2006, Simonato et al. described for the first time the use of lingual mucosa graft [42] that has similar success rate of BMG, but is associated with more frequent speaking and drinking problem in the post-operative time [36–38]. Other common used grafts are penile skin and preputial graft that seem to have a lower success rate of BMG and more complications [39,40]. Other reported graft are tunica vaginalis, bladder mucosa, colonic mucosa and saphenous vein graft. All of these grafts have very low amount of data that limit its routinely using. In conclusion, we have to consider that it is challenging to draw 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 definitions of outcomes. Ultimately, BMG seems to be used safely also for female urethral stricture, but data available are limited.

3.7. Penile Curvature Surgery: Techniques and Functional Results

The BMG can be also used in the 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 [47]. In particular, at this point in the course of the disease, for patient with penile deformity and severe stable penile curvature, erection dysfunction (ED) or penile loss of length, after a comprehensive counselling examining the advantages and disadvantages, a corrective surgery can be proposed to the patient. Over the years, numerous surgical techniques have been developed: the tunica albuginea plication (shortening procedures of the convex part), the plaque incision/plaque excision and grafting (lengthening procedures) and the possible contextual insertion of penile prosthesis in patient with prior ED [48]. The lengthening procedures are specifically indicated for 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 [48]. In these procedures, after degloving the penis without performing a circumcision unless the foreskin is phimotic [49], the surgeon has to assess the curvature of the penis and to 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, being nonetheless the modified H- or double Y-incision the most commonly used, but, on the other hand, the complete excision of the plaque is now a surely abandoned practice due to its increased of DE [50–52]. When we consider the use of a graft to fulfil 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) and non-autologous graft (allograft: human dermis, human pericardium, human fascia lata, human dura mater, human amniotic membrane or xenograft: bovine pericardium, porcine small intestinal submucosa, porcine dermis, equine collagen fleece). Synthetic grafts are no more an option because of their collateral effect and antigenicity [52,53]. All the grafts have pros and cons with none being absolutely superior and their used has to be tailored on the patient willing, on the disease characteristics and on the surgeon experience [48,52]. In this kind of surgery non-autologous graft are generally more popular because of their less morbidity and the minor operative time needed, but the few experiences with BMG are promising. In a small series of 32 patient Zucchi et al. [54] described a patient high satisfaction rate (85%), a low incidence of DE (4%) and an high rate of penile straightening (96%) in patient who underwent BMG IPP surgery. Similar results were reached before by Shioshvili et al. in 2005 [55] and by Cormio et al. in 2009 [56] and have been confirmed by a recent meta-analysis that describe the BMG as the best performing graft [12]. In recent small series also the LMG is showing promising results [57].

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. [58,59].

5. Conclusions and Future Prospective

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 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 disfunction

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