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The Use of Buccal Mucosa in Bulbar Stricture Repair: Morbidity and Functional Outcome

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1. Introduction

Urethral stricture disease is as old as mankind. In the old times urethral strictures were mainly associated with longstanding infectious disease (gonococcal urethritis) or trauma (Beard and Goodyear, 1948). Current stricture aetiology in the developed world is mainly iatrogenic, such as strictures after (traumatic) urethral catheterization or transurethral resection, and idiopathic (Fenton et al., 2005, Lumen et al., 2009). Besides the aetiology of strictures, also the armamentarium to treat them has evolved. Repeated dilatation or, in complicated cases, external urethrotomy or cystotomy were the only treatment options for centuries instead of leaving the disease on its natural evolution. Today, optic urethrotomy, anastomotic urethroplasty and substitution urethroplasty offer better functional results, better cosmesis and in the majority of patients a permanent solution to the disease.

Urethral strictures most frequently occur at the bulbar urethra (Lumen et al., 2009, Fenton et al., 2005, Meeks et al., 2009, Andrich and Mundy, 2008, Santucci et al., 2007). This is the part of the urethra that is surrounded by the corpus spongiosum and the bulbospongiosus muscle. When a bulbar stricture is encountered for the first time in a patient, a direct vision internal urethrotomy can be offered. This may be curative for short strictures in about half of the patients treated. Previous urethrotomy/dilatation or direct vision internal urethrotomy in longer strictures reduces success rates to almost zero (Pansadoro and Emiliozzi, 1996, Steenkamp et al., 1997). This does not mean that the patient cannot be managed this way, but the treatment is palliative in nature and repeat treatments or intermittent self catheterization will be mandatory to maintain patency.

When these patients want to be cured from their stricture disease, an operative approach has to be offered. It is probably better to offer this approach sooner than later. From a surgical point of view, less spongiofibrosis will be found and from an economical point of view, early surgery is probably more cost effective (Rourke and Jordan, 2005, Greenwell et al., 2004, Andrich and Mundy, 2008, Wright et al., 2006).

The operative approach can essentially be divided in anastomotic and substitution urethroplasties. In the first, a tension free, spatulated anastomosis is the key to success. This technique is generally advocated for shorter strictures that can be excised completely. It is assumed that results from end-to-end anastomotic urethroplasty are superior to substitution urethroplasty. This believe is partially based on intuition: excision of the diseased urethra and subsequent restoration of the continuity using healthy ends 'has to be better' then leaving the diseased urethra in place and augmenting it with another tissue. However, the

evidence to support this believe is not solid (Meeks et al., 2009, Andrich et al., 2003). In a substitution urethroplasty, the urethral lumen calibre is restored using flaps (derived from scrotal or penile skin, tunica vaginalis,…) or grafts (skin, buccal mucosa, lingual mucosa, small intestinal submucosa,…) (Mangera et al.). This technique has become more widespread after the introduction of buccal mucosa as a free graft. Buccal mucosa offers a relatively resilient and easy to handle graft, rendering this surgery more accessible.
In the following chapter we will discuss the advantages and disadvantages of buccal mucosa free graft in the treatment of bulbar urethral stricture disease. We will not only focus on success as defined by absence of stricture recurrence but also on functional results and patient reported outcomes.

2. The rationale of using buccal mucosa free grafts in urethral stricture repair

For many years, oral mucosa has been used for reconstructing oral and maxillofacial defects, repairing the conjunctival mucosa of the eye, oral pharyngeal reconstructive surgery and reconstructing vaginal defects (Markiewicz et al., 2007). In 1941, Humby published the first report on the use of oral mucosa for urethroplastic repair, in which he used lingual mucosa graft (LMG) in a patient who had undergone previous unsuccessful hypospadias repair resulting in a fibrotic urethra and a penoscrotal fistula. It was not until 1992 when Burger et al (Burger et al., 1992) reintroduced oral mucosa as a graft source for urethroplastic procedures that the use of oral mucosa in reconstructive urology gained widespread use. A month after the report by Burger et al was published, Dessanti et al (Dessanti et al., 1992) reported on 8 combined bladder mucosa and autologous LMGs for hypospadias repair.
Although there has been some dispute among authors as to who actually reintroduced the oral mucosa graft into contemporary reconstructive urology practice, we credit Burger and Dessanti et al for their groundbreaking work.
The two most common sites of oral mucosa harvest for urethral repair are the labial alveolar and the buccal mucosa. Oral mucosa has a thick nonkeratinized stratified squamous avascular epithelium and a slightly vascular underlying lamina propria (Duckett et al., 1995). Oral mucosa is exceptionally appropriate for urethral substitution because it is architecturally similar to the stratified squamous epithelium of the penile and glandular urethra. Because of sufficient graft surface, oral mucosa is easy to harvest. Frequently exposed to compression, stretching and shearing forces, the oral mucosa is highly resilient. Blood vessels and nerve fibres from the submucosa infiltrate into the lamina propria and provide a mechanism for angiogenesis and revascularization of the tissue when grafting (Duckett et al., 1995). Oral mucosa is resistant to infection because the oral epithelial cells are infused with polymicrobial intracellular and extracellular flora (Rudney and Chen, 2006), the mucosal epithelial cells limit microflora by a specialized immune system (MALT) and the well-defatted lamina propria of the oral mucosa graft is a secondary barrier preventing microorganisms from entering adjacent tissue layers (Walker, 2004).

3. Functional outcome of bulbar urethral stricture repair using buccal mucosa

The functional outcome of urethral surgery is often reported in terms of urethral patency only. Although this is an obvious and essential outcome parameter, since this is the reason for surgery in the first place, it is also important to look into continence, erectile and

ejaculatory function, post void dribbling and patient satisfaction in general. In other words: both the urologist and the patient should be satisfied with the obtained result.

3.1 Success of urethral repair

Bulbar urethral stricture repair using buccal mucosa provides high success rates. Depending on the definition of failure, the length of follow up and the technique used to augment the urethra, success rates vary between 65,8% and 100% with an average of more than 80% (Mangera et al.). Failure can be defined as a certain Q_{max} value using uroflowmetry. This value is easily obtainable, but is a reflection of different functional aspects such as urethral diameter, detrusor contraction and abdominal straining. The diameter of the urethra has to decrease very substantially (to less than 10 french) before a clear impact on flow rate is noticed (Smith, 1966). Abdominal straining can mask low urethral diameters. Therefore this is a variable and relative late sign for failure. Patient reported outcome parameters, such as symptom scores or the need for instrumentation can be used as parameters of failure. One can also expect late diagnosis of recurrence using these methods for exactly the same reasons. Urethrography is advocated by some authors to follow up urethral stricture repair in a more objective way. Others disagree, because images are not always easy to interpret, and argue that endoscopic evaluation gives a clear and objective definition of patency after repair. It is sure that endoscopic evaluation is the only certain outcome parameter. We also promote endoscopic evaluation in the follow up of urethral stricture repair. In retrospective series however it is not always possible to obtain these data. Future studies that are designed in a prospective way should take this into account. It is on the other hand not always easy to perform an invasive investigation on a patient when he reports to be satisfied.

Longer follow up times result in less favourable outcome. Barbagli et al. showed that even after longer time, the number of stricture recurrences rose steadily (Barbagli et al., 1997). It is not clear whether a plateau phase of the recurrence curve is encountered at a certain time point. Follow up times of less than one year might overestimate the success rate of a technique.

Several techniques of bulbar urethral stricture repair using buccal mucosa have been reported in literature. The traditional technique of ventral onlay urethroplasty has reported success rates from 80 to 100% (Meneghini et al., 2001, Morey and McAninch, 1996, Barbagli et al., 2008b, Wessells and McAninch, 1996). One report of 7 patients only had a success rate of 43% (Berger et al., 2005). In a recent meta analysis an overall success rate for ventral onlay urethroplasty of 88,84% with an average follow up of 34,3 months in 563 patients was calculated from the existing literature (Mangera et al., 2011).

Since the first description in 1996 of the dorsal onlay urethroplasty by Barbagli et al., this technique has gained widespread acceptation by urethral surgeons worldwide (Barbagli et al., 1996). Reported success rates are very high and vary from 77,3% to 100% (Barbagli et al., 2008b, Barbagli et al., 2006, Joseph et al., 2002). Again, a pooled analysis of all published data on dorsal onlay urethroplasty calculated an overall success rate of 88,37% for 943 patients treated with an average follow up of 42,2 months (Mangera et al., 2011). In our own series of 61 patients, we encountered an estimated failure free rate of 90,2% with an average follow up of 25,3 months (Vander Eeckt and Joniau, 2010a).

Other, less frequently used techniques, such as lateral onlay urethroplasty, two sided urethroplasty, augmented anastomosis and the Asopa technique have been reported as well. The results of these techniques are comparable to the above mentioned, more classical

techniques. The number of patients treated with these techniques is rather small and the description comes from selected centres (Barbagli et al., 2005, Barbagli et al., 2008b, Pisapati et al., 2009, Palminteri et al.). In augmented anastomotic urethroplasty, reported success rates can attain more than 90% after more than 2 years of follow up in a complex patient population (Guralnick and Webster, 2001).
In large series of end-to-end urethroplasty, comparable outcome is reached with success rates reaching around 90% after 26 and more than 60 months follow up respectively (Gupta et al., 2009, Barbagli et al., 2007).
In our patient population of 103 patients, 61 underwent bulbar stricture repair with a dorsal onlay buccal mucosa graft and 42 underwent an end-to-end repair. The re-stricture rate of buccal mucosa graft repair was not significantly different from end-to-end repair(Vander Eeckt et al., 2010). Preoperative strictures in the former group were significantly longer and a significantly higher number of patients in that group had undergone previous reconstructive urethral surgery. This makes a direct comparison of results impossible, but indicates that dorsal onlay urethroplasty is certainly not inferior to end-to-end repair in our hands.
In general, substitution urethroplasty with buccal mucosa can attain very high success rates which are comparable to anastomotic urethroplasty, even in the longer strictures. Whenever a traction free anastomosis cannot be achieved, one should not hesitate to use free graft repair.

3.2 Post void dribbling

Post void dribbling is a known complication of substitution urethroplasty. This is mainly caused by splitting the bulbourethral muscle longitudinally. The augmentation of the urethra creates a somewhat dilated and atonic part where urine can reside for a while and dribble out in the minutes after micturition. Furthermore, the dissection, transsection or opening of the urethra can create deficient closing mechanisms. The problem is reported to be worse after ventral onlay urethroplasty (up to 1/3 of patients), attributed to increased dilatation of the graft as compared to dorsal onlay urethroplasty (around 1/10 patients) (Fransis et al., 2009, Joseph et al., 2002, Bhandari et al., 2001). These differences are not reproduced by all authors. We even found similar post void dribbling incidences in end-to-end anastomosis as compared to buccal mucosa dorsal onlay urethroplasty when we actively asked patients whether they had post void dribbling (Vander Eeckt and Joniau, 2010a). Although it is an "innocent" symptom, it can lower quality of life. Patients should be counselled preoperatively about this surgical side effect and should be taught how to empty the anterior urethra after micturition. Muscle and nerve sparing techniques might eliminate these side effects of urethral surgery, although only occasional reports have been published to date (Barbagli et al., 2008a).

3.3 Urinary incontinence

In general, urinary continence is not affected by urethroplasty. In certain subgroups of patients however, this might be an expected and invalidating side effect of urethral surgery. Patients that underwent previous prostatic surgery are at specific risk for this invalidating side effect. Also a history of radiotherapy might predispose for this condition. Meeks et al. recently reported on 30 patients with radiation induced strictures. Exactly half (15/30) of the patients developed incontinence. In the minority of patients (3/30) this was a transient phenomenon, but in 12/30 (40%) of patients this incontinence was long lasting. In the end

4/30 (13%) patients finally required an artificial urinary sphincter implant to restore continence (Meeks et al., 2011). This is in accordance with sporadic clinical experience of severe incontinence after complex urological history. It is not always easy to predict this functional outcome, but patients have to be counselled for this possibility since it may have a tremendous impact on the quality of life. Furthermore, bulbar placement of an artificial urinary sphincter might not always be possible, due to the previous urethral surgery.

3.4 Erectile and ejaculatory dysfunction

As illustrated above, the evidence in favor of surgical treatment of urethral stricture disease has accumulated. This trend has caused more concerns about postoperative complications like erectile dysfunction and ejaculatory dysfunction after urethral surgery.

The theoretical risk of **erectile dysfunction** comes due to the close relationship of the cavernous nerves with the proximal urethra when they emerge from the pelvic floor. Nerve fibers emerge from the anterior foramina of S2-S4 and join the fibers from the hypogastric nerve to form the pelvic plexus; The most caudal fibers of the plexus travel along the posterolateral side of the prostate and innervate the corpora of the penis. This is the *cavernous nerve* responsible for penile erection (Lue et al., 1984). The carvernous nerves form several bundles on each side of the urethra at 3 and 9 o'clock positions. At the proximal bulbar urethra some fibers penetrate the tunica albuginea of the corpus spongiosum to innervate the vasculature and erectile tissues of the corpus spongiosum and glans penis. The rest of the fibers remain outside the corpus spongiosum and ascend gradually to the 1 and 11 o'clock positions at the level in which the crura of the corpora cavernosa converge to the midline (Lue et al., 1984).

Yucel et al (Yucel and Baskin, 2003) have shown that the *perineal nerve* may also have a role in erectile dysfunction. Intimate communications ware found between the cavernous, dorsal and perineal nerve fibers and at these communications, the dorsal and perineal nerve (they do not innervate the erectile bodies directly) contain nitric oxide synthase, responsible for production of NO. This suggests that they play a role in vasodilatation of penile arteries.

Normal ejaculation requires 3 steps including ejaculate emission into the urethra by alfa-adrenergic contractions of the prostate, seminal vesicles and vas deferens, bladder neck contraction to prevent retrograde ejaculation and finally semen expulsion from the urethra by bulbocavernous and ischiocavernous muscle contraction. Disruption in one of those steps alter normal ejaculation. The *perineal nerve* (S3-S4) is critical for the bulbocavernous reflex contraction and sensory function of the perineum. After the pudendal nerve leaves the pudendal canal it gives rise to the perineal nerve branches. Perineal nerves travel along the ischiocavernous and bulbospongiosus muscles. Fine nerve fibers arise from the lateral trunk and travel to the junction of the two muscle bellies in the midline to pierce into the midline and send branches to the corpus spongiosum.

The *dorsal nerve* of the penis is the deepest division of the pudendal nerve. It gives branches to the corpus cavernosum of the penis and goes on to the dorsum of the penis and ends in the glans penis; It innervates the skin of the penis. (Yang and Bradley, 1999)

Previous studies have focused more on stricture recurrence and incontinence and only a small part of the reports discussed erectile dysfunction. More recent reports are starting to evaluate potency after urethral stricture repair.

Mundy et al (Mundy, 1993) was the first to comment on ED after urethroplasty, reporting a permanent ED rate of 5% after anastomotic repairs and 0,9% after graft urethroplasty. Coursey et al (Coursey et al., 2001) reported in 2001 a retrospective analysis of 250 men after

urethroplasty. At a mean follow-up of 36 months 26,8% was not satisfied with the erection after anastomotic urethroplasty and 19,2% after buccal mucosa graft. Anger et al (Anger et al., 2007) were the first to publish a prospective study of 25 men undergoing bulbar urethroplasty using the IIEF questionnaire. They found that urethroplasty had no significant effect on erectile function. Also Barbagli et al (Barbagli et al., 2007) reported no impotence in a review of 153 patients with an average age of 39 years who underwent bulbar end-to-end anastomosis. Erickson et al (Erickson et al., 2010) published a prospective study of 25 men using the IIEF score. Although there was no statistically significant difference between the ED after anastomotic (50%) versus buccal mucosa graft urethroplasty (26%), there was a trend towards a higher rate of erectile dysfunction after anastomotic repair. Xie et al (Xie et al., 2009) published prospective study of 152 patients after urethroplasty. Postoperatively 69,6% patients had an increased erectile dysfunction. However, there was a rebound of IIEF-5 score at 6 months post-operatively, but this was only observed in men younger than 40 years. End-to-end anastomosis was associated with an lower IIEF-5 score.

In our experience, we performed a retrospective comparison between a bulbar urethroplasty were the urethra was transected (anastomotic and buccal mucosa roof strip augmented urethroplasty) and a bulbar urethroplasty were the urethra was not transected (dorsal inlay buccal mucosa urethroplasty) (Vander Eeckt and Joniau, 2010b). We saw a significant lower IIEF-5 postoperatively after transecting the urethra (P=0,0017). After urethroplasty were the urethra was not transected the IIEF-5 was not significantly lower (P=0,21).

All presented studies have limitations; They have a limited follow-up, small population and not all studies are prospective. The largest limitation is the lack of a validated questionnaire, specifically created for erectile function after urethroplasty; changes in angle of the erection, length of the penis, swelling of the glans or changes in penile sensitivity.

Despite these limitations, a trend toward increased erectile dysfunction after anastomotic bulbar urethroplasty compared with buccal mucosa graft urethroplasty is seen. The exact reason is not yet known but there are some hypotheses:

i. Extensive dissection and mobilization at the level of the convergence of the corpora cavernosa in anastomotic urethroplasty may damage the cavernous nerves at that level. Sometimes even splitting of the corpora cavernosa is necessary to avoid traction on the anastomosis;
ii. In order to expose the underlying corpus spongiosum, splitting of the bulbospongiosus muscle is necessary. This is frequently accompanied by a disruption of the perineal nerves. In order to avoid this, Barbagli et al (Barbagli et al., 2008a) described a muscle and nerve sparing bulbar urethroplasty using buccal mucosa. Unfortunately this is not possible for anastomotic urethroplasty. Therefore, damaging the perineal nerves occur more in anastomotic urethroplasty than in buccal mucosa urethroplasty. As noted in "part one" the perineal nerve is not only responsible for ejaculation but has probably a role in erectile function. (Yucel and Baskin, 2003)
iii. At the proximal bulbar urethra, some cavernous fibers penetrate the tunica albuginea of the corpus spongiosum to innervate the vasculature and erectile tissues of the corpus spongiosum and glans penis. Transection of the urethra during a anastomotic urethroplasty not only implies suturing this vasculature but also the nerve fibers close to and in the corpus spongiosum.

Ejaculatory function following urethroplasty has been studied considerably less than erectile dysfunction.

The effect of urethroplasty on ejaculation has not yet been proved but there are some hypotheses. On the one hand obstruction relief may allow semen to travel with less impedance through the urethra, on the other hand splitting through the bulbocavernous muscle and dissecting around the urethra might harm neurovascular integrity.

Author	Number of pts (FU in months	End-to-end	Buccal mucosa
Mundy et al. BJU (Mundy, 1993)	200 (?) (? M)	5%	0.9% ("patch")
Coursey et al. J Urol (Coursey et al., 2001)	82 (36 m)	26.8%	19.2%
Anger et al. J Urol (Anger et al., 2007)	25 (6.2 m)	Global: no difference in preop and postoperative ED 1/8 end-to-end: wel postop ED	
Barbagli et al. J Urol (Barbagli et al., 2007)	60 (68 m)	Global: no difference in preop and postoperative ED 31.6% 'neurovascular disorder'	
Erickson et al J Urol (Erickson et al., 2010)	35 (6,2m)	50%	26%
Our experience (Vander Eeckt and Joniau, 2010a)	48 (25 m)	26.1%	15.4%

Table 1. Erectile dysfunction after urethroplasty

Barbagli et al (Barbagli et al., 2007) reported ejaculatory dysfunction in a study of 60 patients after anastomotic urethroplasty but not after the use of buccal mucosa. There were 14 patients (23.3%) who experienced ejaculatory dysfunction, 1 (1.6%) a cold glans during erection, 7 (11.6%) a glans that was neither full nor swollen during erection and 11 (18.3%) had decreased glans sensitivity. No patients complained of penile chordee or impotence. Erickson et al (Erickson et al., 2010) is the first who presented a prospective analysis of ejaculatory function after anterior urethral reconstruction using the Male Sexual Health Questionnaire. A total of 43 men were included, the overall ejaculatory score did not change postoperatively at a mean follow-up of 8,1 months but men with a poor preoperative function had a significant improvement. Postoperative function was stable in 70%, improved in 19% and worsened in 11%. There was no significant difference between the penile and bulbar urethroplasty. Unfortunately, he made no difference between anastomotic or buccal mucosa graft urethroplasty.

In our experience, we compared the ejaculatory function between anastomotic urethroplasty and a urethroplasty with buccal mucosa. The remembered ejaculatory dysfunction was around 33-38%. Postoperatively patients after anastomotic urethroplasty had more ejaculatory dysfunction (45%) when compared to buccal mucosa urethroplasty (30,7%) (P=0,033) (Vander Eeckt and Joniau, 2010a).

3.5 Donor site morbidity

Before harvesting buccal mucosa, the surgeon must be aware of the anatomy of the buccal cavity. The buccal cavity is innervated by the long buccal nerve and by the second division of the trigeminal nerve. Additionally, there is sensory innervation from the facial nerve. The

blood supply originates from a branch of the buccal artery, a branch of the maxillary artery and a branch of the superficial temporal artery. The surgeon must be aware of the Stenson's' duct that originates of the parotid gland. The orifice is visible by a papilla on the mucosa. Underneath the mucosa lies the buccinator muscle. Failure to operate away of these structures may result in damage to the parotid duct with postoperative symptoms of the salivary obstruction; limitation of oral opening because of scarring and contracture; intra-operative hemorrhage; diminished ability to eat and drink; postoperative infection; pain, swelling, and injury to the long buccal or mental nerves with subsequent paresthesia or anesthesia of the cheek.

Nasal endotracheal intubation is preferred to facilitate to the oral cavity, although oral endotracheal intubation is possible. The patient is positioned for a two-team approach to reduce the patient's time in the lithotomy position. Two separate surgical tables are prepared to minimize contamination of the oral wound to the urologic wound. After measuring the intraoperative urethral defect, the extent and shape of the buccal mucosa graft must be marked by a surgical pen. The surgeon must be aware that the graft shrinks up to 20% of their original size. Care must be taken to stay at least 8 mm below the papilla of stenson's duct and at least 1cm behind the vermillion border. Local anesthetic is injected to decrease the bleeding, help elevate and hydro-dissect the buccal mucosa from the underlying soft tissue. Blunt and sharp dissection with a metzenbaum scissors may be used. The intraoral wound can be closed or left open. Then the harvest tissue is prepared by removing any muscle or adipose tissue. The prepared graft is kept in a 0,9% saline solution until used for reconstruction.

Although the buccal mucosa is the graft of choice in many circumstances, only few data about the morbidity of the harvest site are available (table 2).

Early complications such as **bleeding** did not occur in the first reports (Kamp et al., 2005, Eppley, 1997, Burger et al., 1992, Tolstunov et al., 1997, Morey and McAninch, 1996, Wood et al., 2004). More recent studies report postoperative bleeding between 2,5 and 21%. In most of the patients it is self-limiting but some patients need immediate surgical revision of the harvesting site (Barbagli et al., 2010, Fabbroni et al., 2005).

After buccal mucosa harvest patient could expect some **pain and discomfort**. Abdel-Galil et al (Abdel-Galil et al., 2009) reported a prospective study of 24 patients using a visual analogue pain scale of the harvest site and the perineum the first 48h. This shows that the perineal pain was significantly higher than the pain at the donor site ($p< 0,001$). Almost all patients have immediate postoperative pain but this usually resolves within 3 weeks postoperatively (Tolstunov et al., 1997, Jang et al., 2005, Kamp et al., 2005, Dublin and Stewart, 2004). Two studies compared the postoperative morbidity after harvesting of the lip versus buccal mucosa. Harvesting from the lip resulted in significantly greater long-term morbidity, this seems due to the long-lasting neuropathy of the mental nerve (Kamp et al., 2005, Jang et al., 2005). Some studies compared closure versus non closure of the buccal mucosa graft harvest site (Wood et al., 2004, Muruganandam et al., 2009). Pain appears worse in the immediate post operative period with suturing of the harvest site. It may be best to leave the buccal mucosa harvest site unsutured.

Patients who have had a BMG harvest can also expect to have a limited range of **jaw opening** (Dublin and Stewart, 2004, Tolstunov et al., 1997). Tolstunov et al (Tolstunov et al., 1997) measured the preoperative mouth opening preoperatively, and then after 1week, 2-3-6 weeks and 6 months. Almost all patient had difficulties with mouth opening the first week postoperatively, but all patients returned to their preoperative mouth opening; Recent

studies did report persistent difficulties in jaw opening between 1,7 and 32%. Jang et al compared the morbidity between labial and buccal mucosa. Contractures were more common in patients whose grafts were harvested from the cheek, presumably from the increased incidence of closure of the harvest site. Because of this, it is better to leave the harvest site open.

After reconstruction of extensive strictures using large grafts, patients can expect more **neurosensory deficit** than after a small graft. These deficits usually last up to 1 month. Some studies reported a persistent oral numbness between 3,77 and 40% (Wood et al., 2004, Dublin and Stewart, 2004, Kamp et al., 2005, Jang et al., 2005, Castagnetti et al., 2008). LMG harvest is associated with a greater chance of mental nerve damage then BMG harvest because of the anatomy of the mental nerve. Jang et al (Jang et al., 2005) published a study were he compared morbidity after labial and the buccal harvest sites. BMG harvest was associated with less postoperative discomfort, less neurosensory defect.

No cases with permanent damage to the parotid duct with resulting salivary flow obstruction have been reported. Damaging the salivary glands, mild temporary decrease of **salivary flow** is reported. In most of the patients this resolved in the first week (Tolstunov et al., 1997), although in 2,6%-11% of the patients a slight or moderate dry mouth persisted (Wood et al., 2004, Castagnetti et al., 2008). Comparing morbidity after labial and the buccal harvest sites, Jang et al (Jang et al., 2005) reported less salivary flow after Labial mucosa graft than BMG. Less salivary flow would be expected because the labial mucosa contains more minor salivary gland tissue than the buccal mucosa (Tolstunov et al., 1997). It is nearly impossible to harvest a labial mucosa graft without interfering with the salivary secretion.

Some studies assessed the **quality of life** after harvesting oral mucosa. A recent large study of 350 patients by Barbagli et al. (Barbagli et al., 2010), assessed the QOL. In response to the question, "would you undergo buccal mucosa graft harvesting using this technique again", only 2% said 'no' to the question. Dublin et al (Dublin and Stewart, 2004) asked a similar question and reported that 3% of the patients were dissatisfied and 23% had mixed feelings. Comparing LMG and BMG harvest patients after LMG harvest (50%) seemed less satisfied than those after BMG harvest (8,3%). This was not confirmed in the study of Jang et al, probably because their QOL of life assessment reflected more the outcome of the reconstructive surgery than the morbidity of the harvest site.

In our experience early complications are rather frequent. We performed a retrospective analysis of 91 patients with a in-house developed questionnaire. During the first two weeks after surgery, up to 14,3 % of the patients had pain and 45.5% had problems with eating solid food, 32.1% had jaw opening impairment and 26,8% had oral numbness. After a median follow-up of 31,4 months, oral numbness remains the most important complaint (up to 20,4%), while 2,3% had problems with contractures (Vander Eeckt and Joniau, 2010c). These results are comparable with the result mentioned in the literature. Other complaints were infrequent after six months.

All studies about the morbidity of buccal mucosa graft taking, have limitations. First, some complaints like pain or neurosensory deficit are difficult to evaluate objectively. Second, although most of the questionnaires are reliable, all studies are limited because of the absence of validated instruments to evaluate pain, the harvest site morbidity, and typical quality of life changes. Third, most of the studies have small patient numbers and limited follow-up. The development of validated questionnaires and large prospective studies are needed to assess the morbidity after oral mucosa graft taking.

Author(s)	year	FU months	short term (%)		long term complications (%)			
			Pain	Hematoma	numbness	jaw opening	pain	Less salivary flow
Burger et al (Burger et al., 1992)	1992		no complications					
Morey et al (Morey and McAninch, 1996)	1996	18	no complications					
Tolstunov et al (Tolstunov et al., 1997)	1997	3		0	0	0		0
Eppley et al (Eppley, 1997)	1997		0	0			0	
Dublin et al (Dublin and Stewart, 2004)	2004	13.6	64	0	16	32	0	
Wood et al (Wood et al., 2004)	2004		83		26	9		11
Kamp et al (Kamp et al., 2005)	2005	12.5	100	0	25		16	
Fabbroni et al(Fabbroni et al., 2005)	2005	3		4.3		4		
Jang et al (Jang et al., 2005)	2005	12	4.67	2.5	40	20	0	
Castagnetti et al (Castagnetti et al., 2008)	2008	7.6y		21	28	2.6		2.6
Barbagli et al (Barbagli et al., 2010)	2010	6	3.7	4.3	3.77	1.7		2.9

Table 2. Reports on long term morbidity associated with buccal mucosa harvest site

4. Conclusions

Bulbar urethral stricture disease is a curable disease. Palliative treatment such as recurrent dilatations or urethrotomies should only be offered to very selected patients with high comorbidities or who refuse surgery. Stricture repair using buccal mucosa offers a technique that has proven to be effective and reproducible with high stricture-free rates.

However, buccal mucosa graft harvesting is not without morbidity and when reporting the success of urethral surgery, one should also take into account surgical morbidity, functional results and patient satisfaction.

At the functional level, *post void dribbling* will occur relatively frequently after stricture repair. When patients are counselled preoperatively for this side effect and when they are learned to empty their urethra manually, this side-effect becomes manageable and accepted by most patients.

Urinary incontinence is a rare but devastating complication of stricture repair in a selected group of patients. In these difficult cases, one should only embark in stricture repair after careful counselling and after discussing potential future therapies to treat incontinence.

The consequences of urethral stricture repair on *sexual function* are not entirely clear.

As shown above, studies on ejaculatory dysfunction are few in numbers and small in study size. More studies are needed, but this is not easy because of the lack of standardization in pre- and postoperative investigations and the absence of validated questionnaires including

measurement of bulbocavernous muscle contractile potential, ejaculation latency time, ejaculate volume… Similarly, typical changes in erection after urethral surgery ('cold glans syndrome', sensory deficit at glans level, chordate, curvature, shortening of penile length) are not captured by commonly accepted erectile function scales (like IIEF-score). Nevertheless, compared to anastomotic repair, buccal mucosa graft urethroplasty seems to cause less erectile dysfunction.

Notwithstanding these shortcomings in the literature, this chapter has clearly shown that the use of oral mucosa free grafts leads to excellent stricture-free rates. Furthermore, functional results (more specifically, erectile function results) surpass those of other reconstructive approaches, while graft site morbidity is very acceptable in the short term and almost negligible in the long term.

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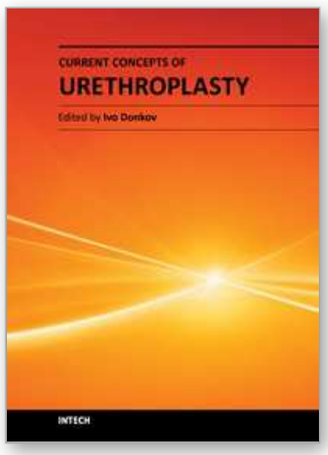

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Urethral reconstructive surgery has always been a challenging part for urologist since the dawn of our speciality. In this book leading experts in lower urinary reconstructions from all over the world present their views and experience in that field, together with practical tips and tricks. The book is an excellent source of information for those who are already dealing with urethral surgery, and also an invaluable companion for urologists in training or those who want to dedicate themselves to this great sub-specialty. This book is an excellent reference guide and companion on the way to operating and consulting room, or when writing an article and reviewing the current practices. The abundance of methods and continuing development of new approaches to the problem prove the complexity of it.

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