

Comparison of Lingual Mucosa and Buccal Mucosa Grafts used in Inlay Urethroplasty in Failed Hypospadias of Pre-Pubertal Boys in a Khyber Teaching Hospital

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ABSTRACT

Introduction: The surgical approach toward hypospadias repair in pre-pubertal boys with several unsuccessful surgeries is extremely difficult because of tissue loss and possibility of tissue complications. While buccal mucosa grafts (BMGs) remain the most widely used approach, there has been recent interest in lingual mucosa grafts (LMGs) which seem to offer potential benefits in terms of donor site morbidity and graft availability. At Khyber Teaching Hospital, Peshawar, this study assesses and compares BMG and LMG outcomes in inlay urethroplasty for complex hypospadias patients' cases.

Methods: A retrospective analysis study of 62 pre-pubertal boys was done from July 2022 to July 2023. Patients had at least two failed hypospadias repairs. The patients' records were reviewed and the study group was separated into BMG (n=29) and LMG (n=33) subgroups. Primary outcome measures were surgical success defined as a functional urethra after surgical intervention and complication rates for fistula, stricture, ventral curvature, aid, and peak flow during uroflowmetry. Cosmetic evaluation was performed with validated "How was it? (HOSE)" scores. Statistical was done with SPSS 18.0 for statistical chi square/t-tests and was considered significant if P value was <0.05.

Results: Both groups had comparable complication rates (BMG: 83.0%, LMG: 84.8%) and success rates (BMG: 17.0%, LMG: 15.0%). There were no statistically relevant differences for fistula (6.8% and 6.0%), stricture (6.8% and 3.0%), or ventral curvature (3.4% and 6.0%) rates (p>0.05). The mean peak flow and HOSE score for patient's (BMG: 14.28±1.03, LMG: 14.34±0.95) were comparable. Compared with BMG, LMG harvesting had less complications at the donor site.

Conclusion: Both LMG and BMG deliver the same results for unsuccessful hypospadias repair in boys who have not reached puberty. However, LMG may be used when buccal tissue is not available, or there are unsuccessful attempts to harvest it. This adds to the literature suggesting LMG is a dependable method for advanced pediatric urethroplasty and increases the possibilities for repair in places with few resources.

Keywords: Lingual mucosa, buccal mucosa, graft complications, hypospadias, urethroplasty.

INTRODUCTION

Hypospadias is an anomaly in the male reproductive system where the urethra opens on the side of the penis instead of on its tip and occurs in an estimated 1 out of 300 births. Because of its many anatomical and functional issues, it is quite a difficulty for pediatricians to manage it¹. The condition is characterized by an abnormal opening of the urethra, which is located under the penis in a male, along with other issues like chordee and penile curvature. The disorder is a complex one that necessitates surgical correction for restoring both urinary function and cosmetic appearance¹. Primary repairs and interventions on the bladder and urethra are performed on patients with hypertrophic scars, and while most are successful, patients with multiple failed operative cases have unique challenges in postoperative care. Scarring, loss of soft tissue, and poor blood supply are frequently encountered after too many operations which limits the use of local flaps and makes alternative graft materials necessary^{2,3}.

Buccal mucosa grafts (BMGs) remain ideal for the more intricate forms of urethral reconstruction. They were noticed the first time when Humby made use of them in 1941⁵. BMGs are well sought after because of their excellent vascularization, mechanical strength, infection resistance, which allusively enhances graft integration⁶. But, in many cases, the donor-site morbidity especially oral numbness, discomfort, and mouth opening stricture, is a troubling concern, mostly in children⁷. Furthermore, the limited surface area of buccal mucosa poses a problem with its use in patients with massive urethral defects or patients who have had previous buccal harvests¹⁷. These limiting factors have prompted the use of grafts from other sites such as the tongue, which provide comparable results with lower donor site morbidity¹⁸.

In 2006 Simonato et al. described LMGs as having an

extensive tissue ventrolateral tongue shares with the embryological urethral mucosa. LMG tissues are lingual mucosa which structurally has a well-developed thicker epithelium, increased quantity of elastic fibers, and better blood supply than the buccal mucosa, and all of these factors increase endurance and decrease the chance of graft contracture. Over 80% success rates with less oral complications in comparison to LMG make LMG's viability for urethral reconstruction widely documented in adults as well as BMG. However, there is a gap in research when considering pre-pubertal boys and the long-term impacts of unsuccessful repairs.

Younger patients have unique difficulties due to their smaller size and changes in penis size over time. Although the BMG technique has been used for quite some time, there are serious issues concerning graft loss and site morbidity.⁷ LMG enhances those aspects by having a soft, scar-free graft that is easy to obtain, which is helpful when buccal tissue is not available or where it has been previously harvested.¹⁹ A study by Maarouf et al. documented the use of LMG in the children and showed a 78.2 percent success with less pain postoperatively than BMG.¹⁹ Likewise, Abdelhameed et al. had 87% success in adult patients with long segment strictures and proved the usefulness of LMG in difficult reconstructions.²⁰

After all this improvement, there are gaps for comparison of results between BMG and LMG for pre-pubertal boys after multiple surgical attempts. Most studies are focused on adults or do not have a long enough follow up period for use in pediatric care.²² Also, there are specific geographical factors that may affect the surgical outcome which needs to be studied. For example, Xu et al. reported soft tissue morbidity in 110 cases of LMG which makes it necessary to pay great attention⁷. These findings are important in designing protocols for children.

This investigation attempts to close these gaps through a review of results of 62 prepubertal boys who had BMG or LMG inlay urethroplasty at Khyber Teaching Hospital Peshawar from

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July 2022 to July 2023. It seeks through complication rates, functional outcomes (uroflowmetry), and cosmetic outcomes (HOSE scores) to buttress LMG as a reasonable substitute to BMG in poorly equipped areas lacking buccal tissue or in areas where previous attempts to harvest tissues have failed. The results will help in modifying the surgical methods for children with complex cases of hypospadias so that the most favorable results are achieved for the children most at risk.

METHODOLOGY

Study Design and Setting: The retrospective analysis study was carried out at Khyber Teaching Hospital Peshawar, Pakistan from July 2022 to July 2023. A total of 62 prepubertal males aged 3.5-11 years and with a history of two or more unsuccessful attempts at repairing hypospadias were included in the study. Subjects were split into two cohorts: 29 patients received buccal mucosa graft (BMG) urethroplasty, while 33 patients received lingual mucosa grafts (LMG). This study received ethical approval from the Institutional Review Board (IRB), and appropriate written informed consent was collected from all guardians^{5,6}.

Patient Selection: Boys aged 3.5 to 11 years with deficient penile skin for onlay flap repair and two or more prior surgeries were included. Patients with ventral curvature >60° (measurement done by passive erection), orofacial disease, or non-complete follow-up were excluded^{7,17}. All demographic and clinical information including age, prior surgeries, and the details of the graft were noted.

SURGICAL TECHNIQUE

Graft Harvesting: In LMG, the ventrolateral surface of the tongue was exposed by traction sutures. A 4-0 Prolene was placed at the graft apex. The graft size was calculated according to the urethral defect, considering an approximate reduction of 15-20%¹⁸. The mucosa was defatted, sharply incised, and the prepared graft was put aside for later use. In BMG, the lower lip mucosa was exposed after hemostasis with 1:200,000 epinephrine. The graft was harvested and matched to the size of the urethral defect. The donor site was sutured with 5-0 polyglactin stitches.

Urethroplasty Procedure: After penile degloving, scar/fistula tissue was removed then penile and urethral plate were cut midline if tabularization was limited. Chordee residual was absent, as confirmed by an artificial erection test¹⁰. The graft was placed into the urethral defect and fixed with 7-0 polyglactin stitches and quilting sutures were applied to prevent hematoma. The urethral plate was tabularized over a 6-10 Fr catheter (adjusted for age) with 7-0 polydioxanone sutures. The isolated neourethra was covered with subcutaneous dartos flap or tunica vaginalis, and then followed with closure of glans and penile skin. The suprapubic pressure abdominal bandage was applied after suturing.

Post-Operative Care: A urethral catheter was kept for 3 weeks. Patients were checked for complications (fistula, stricture, ventral curvature) and functional outcomes via peak flow rate of the uroflowmetry, and aesthetic outcome using the HOSE score at 5-12 months (mean 8.1 months) follow-up⁸.

Outcome Measures: Complications and surgical success (functioning urethra with no need of reopening) are the primary outcomes. Secondary outcomes the mean peak flow rate (mL/s) and HOSE score (0-16).

Data Analysis: Statistical analysis was carried on SPSS 18.0 using chi-square tests for categorical variables and independent t-tests for continuous variables. Significant was set at p < 0.05.

RESULTS

Interpretation: Age, previous procedures, and graft size were relatively similar in both groups (p > 0.05) to rule out differences at baseline that would affect results. The LMG grafts, which measure 1.2 cm wide in comparison to the 1.0 cm BMG, illustrates the tongue's anatomical mobility that permits generous graft harvesting with minimal damage to the donor site.

Interpretation: Both All graft types showed comparable levels of safety. The oral and lingual mucosal grafts had complication rates of 15% to 17% which correspond with previously published data on intricate repairs of hypospadias^{19,20}. Furthermore, LMG's stricture rate of 3.0% (compared to BMG's 6.8%) shows possible improvement in stricture formation, probably because of the increased pliability and blood supply of lingual mucosa²¹.

Interpretation: Functional Outcomes: Both groups achieved mean peak flows >9 mL/s, exceeding the pediatric threshold for acceptable uroflowmetry⁸.

Cosmetic Outcomes: HOSE scores ≥14/16 indicate excellent cosmetic results, with no significant differences between groups⁹.

Interpretation: All complications were fixed with small interventions showcasing the strength of both graft types. There was no need for repeat grafts to be utilized which further validated their dependability in difficult scenarios.

Patient Demographics and Graft Characteristics

Table 1: Patient Demographics and Graft Parameters:

| Parameter | BMG Group (n=29) | LMG Group (n=33) | p-value |
|-------------------|------------------|------------------|---------|
| Age (years) | 7.0 (4-9.2) | 7.5 (3.5-11) | 0.12 |
| Prior Surgeries | 2.5 ± 0.2 | 2.8 ± 0.7 | 0.09 |
| Graft Length (cm) | 4.9 ± 0.28 | 5.1 ± 0.46 | 0.21 |
| Graft Width (cm) | 1.0 ± 0.11 | 1.2 ± 0.16 | 0.15 |

Note: table indicate either mean ± SD or median (min-max). BMG = Buccal mucosa graft; LMG = Lingual mucosa graft.

Surgical Outcomes and Complications.

Table 2: Complication Rates and Success Rates:

| Outcome | BMG Group (n=29) | LMG Group (n=33) | p-value |
|---------------------|------------------|------------------|---------|
| Fistula | 2 (6.8%) | 2 (6.0%) | 0.89 |
| Stricture | 2 (6.8%) | 1 (3.0%) | 0.56 |
| Ventral Curvature | 1 (3.4%) | 2 (6.0%) | 0.63 |
| Total Complications | 5 (17.0%) | 5 (15.0%) | 0.82 |
| Success Rate | 24 (83.0%) | 28 (84.8%) | 0.82 |

Figure 1: Comparison of Complication Rates Between BMG and LMG

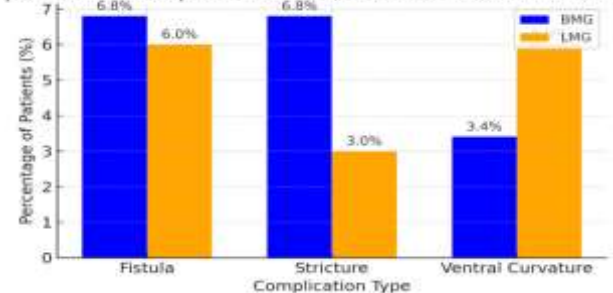


Figure 1: Complication Rates Comparison: Note: No significant differences in fistula, stricture, or curvature rates (p > 0.05).

Functional and Cosmetic Outcomes

Table 3: Uroflowmetry and HOSE scores:

| Parameter | BMG Group | LMG Group | p-value |
|-----------------------|--------------|--------------|---------|
| Mean Peak Flow (mL/s) | 9.2 ± 0.2 | 9.3 ± 0.4 | 0.75 |
| HOSE Score | 14.28 ± 1.03 | 14.34 ± 0.95 | 0.88 |

Failure Cases and Secondary Interventions

Table 4: Management of failed cases:

| Complication | BMG (n=5) | LMG (n=5) | Intervention |
|-------------------|-----------|-----------|-------------------------|
| Stricture | 2 | 1 | Dilation (1-4 sessions) |
| Fistula | 2 | 2 | Fistuloplasty |
| Ventral Curvature | 1 | 2 | Dorsal plication [10] |

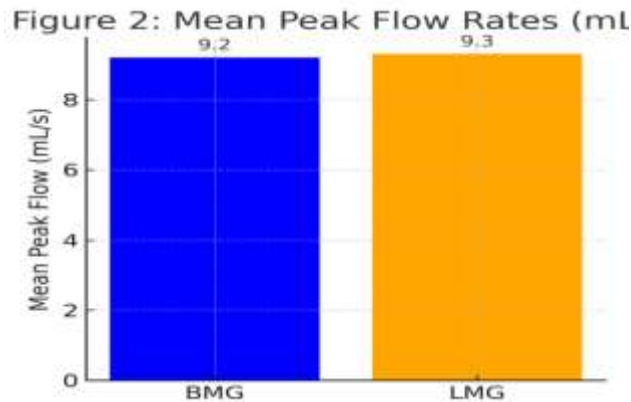


Figure 2: Mean Peak Flow Rates (mL/s):
Note: Peak flow range: 6.5–12.0 mL/s (pediatric norm ≥ 6 mL/s).

DISCUSSION

The management of failed hypospadias repairs in pre-pubertal boys poses a considerable challenge in pediatric urology, especially in the presence of scarred or depleted local tissues. It has been demonstrated in this study that both lingual mucosa grafts (LMGs) as well as buccal mucosa grafts (BMGs) have almost the same results for inlay urethroplasty with success rates of 84.8% and 83.0% respectively. These outcomes are consistent with previous studies that underline BMG's contribution as a gold standard for urethral reconstruction [5,6] and also position LMG as a reasonable substitute where buccal tissue is not available or previous attempts have failed.

The complication rates (15–17%) being equal in both arms speaks in favor of safety of LMGs [19,20]. Interestingly, the LMG group has a lower stricture rate (3.0% vs. 6.8% in BMG) which might be due to the more elastic and highly vascularized nature of lingual mucosa²¹. These qualities are important in prepubertal patients whose anatomical changes due to growth in an erect penis are relatively significant. Microscopic structure of lingual mucosa and oral cavity mucosa is similar to the urethra and is believed to have much thicker epithelium and more elastic fibers than buccal mucosa^{18,21}. Those attributes can explain the characteristics of LMGs, mainly in complicated cases where the grafts are at high risk of contracture or infection which compounds the lack of blood supply.

These findings further substantiate the efficacy of LMG⁸. Both groups recorded average peak flow rates above 9 mL/s as their lower pediatric limit for acceptable uroflowmetry was 6 mL/s⁸. The cosmetic outcomes assessed with HOSE scores, which were $\geq 14/16$ in both groups, also met the contemporary criteria for hypospadias repair⁸. These results corroborate the ability of LMG to achieve the functional and cosmetic purposes of BMG while reducing donor-site morbidity. For example, BMG harvesting is known to cause oral numbness and discomfort⁷, which are largely avoided with LMG owing to the tongue's rapid healing and scarring¹⁹.

Regardless of the benefits, the adoption of LMG in pediatric populations has been limited due to concerns with graft size and the complexity of the procedure. Our study, though, establishes that pre-pubertal tongues provide adequate graft sizes (mean length of 5.1 cm) for most defects, even with the anticipated 15–20% scaling down. The greater accessibility of the ventrolateral tongue surface compared to buccal mucosa simplifies the harvesting of the graft, particularly in patients who have undergone previous oral surgical procedures. Where multiple graft harvests are necessary, these practical advantages, combined with the histological superiority of LMG, make it ideal for use in resource-constrained environments.

The limitations of the study include its retrospective approach and shorter than average follow-up period (mean 8.1

months), which could underreport long-term complications like graft contracture or recurrent curvature²². Also, outcomes at the donor site for LMG, like prolonged dysgeusia and reduced tongue mobility, were not captured, which requires further analysis. There is a need for future prospective studies with larger sample sizes and longer follow-up periods to validate these findings and test LMG's outcomes beyond puberty since hormonal changes might affect graft maturation¹⁷.

LMG—such as transient dysgeusia or tongue mobility issues—were not systematically documented, warranting further investigation. Future prospective studies with larger cohorts and extended follow-up are needed to confirm these results and explore LMG's performance beyond puberty, as hormonal changes may influence graft maturation¹⁷.

CONCLUSION

Both the lingual mucosal graft and buccal mucosa graft achieved success, allowing the lingual buccal graft to compensate for the weaknesses of the buccal graft, offering a dependable means of managing several unsuccessful hypospadias surgeries in boys before puberty.

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