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TREATMENT OF FEMALE URETHRAL STRICTURE WITH VENTRAL-INLAY BUCCAL MUCOSAL GRAFT URETHROPLASTY: A COHORT STUDY.

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ABSTRACT

Background

A rare but serious disorder that lowers quality of life and causes severe urine symptoms is called female urethral stricture disease, or USD. More successful surgical interventions are required because traditional treatments like internal urethrotomy and urethral dilation frequently have significant recurrence rates. In female patients with urethral stricture, the aim of this study was to assess the safety and efficacy of ventral-inlay buccal mucosal graft urethroplasty.

Methods

Twenty females with urethral stricture were included in prospective observational research. Individuals with neurogenic bladder or abnormal neurological examination results were not accepted. Cystoscopy was used to confirm the diagnosis. Following surgery, patients were monitored for 3, 6, and 12 months, during which time uroflowmetry, postvoid residual urine (PVRU), and American Urological Association (AUA) symptom scores were measured. Paired t-tests were used for statistical analysis.

Results

Significant surgical improvements in urinary symptoms and flow rates were shown in the study. After surgery, the average AUA symptom score dropped from 18 ± 3.5 to 4 ± 1.2 at 12 months ($p < 0.001$). The maximal urine flow rate (Qmax) increased from 8.5 ± 2.1 ml/s to 20 ± 3.0 ml/s ($p < 0.001$), and the mean PVRU dropped from 150 ± 45 ml to 20 ± 10 ml ($p < 0.001$). Recurrence was detected in 15% of patients, with few problems recorded.

Conclusion

Ventral-inlay buccal mucosal graft urethroplasty significantly improves urinary symptoms and flow rates in female patients with urethral stricture, demonstrating its effectiveness and safety with low recurrence and complication rates.

Recommendations

It is advised to do more studies with bigger sample sizes and longer follow-up times in order to confirm these results and create standardised treatment guidelines for female urethral stricture.

Keywords: *Female Urethral Stricture, Buccal Mucosal Graft, Urethroplasty, Urinary Symptoms, Surgical Outcomes*
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INTRODUCTION

Female urethral stricture disease (USD) is a relatively rare but debilitating condition described by the narrowing of the urethra, leading to significant urinary symptoms and compromised quality of life. The incidence of female USD is lower compared to males, and its etiology can be multifactorial, including iatrogenic causes, inflammatory diseases, and trauma [1]. Despite its low prevalence, the impact of urethral stricture on women's health is substantial, necessitating effective and reliable treatment options.

Traditional management of female USD has often involved urethral dilations and direct visual internal urethrotomy (DVIU), but these approaches are correlated with high recurrence rates and do not offer a permanent solution [2]. Recent advancements in surgical techniques have brought urethroplasty to the forefront as a durable and effective alternative. Among these, ventral-inlay buccal mucosal graft urethroplasty (VIBMGU) has gained attention for its promising outcomes.

The use of buccal mucosa in urethral reconstruction is well-established in male patients, and its application in females is becoming increasingly recognized. Buccal mucosa is favored due to its robust, resilient, and non-hair-bearing properties, making it an ideal graft material for urethral reconstruction [3]. The technique involves harvesting a graft from the inner cheek and placing it in the urethral bed to augment or replace the strictured segment, promoting healing and maintaining patency.

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Despite the advancements, the literature on VIBMGU in females remains sparse, with limited studies providing detailed outcomes and long-term follow-up data. This gap underscores the need for more comprehensive research to validate the efficacy and safety of this technique in female patients [4].

The study evaluated the effectiveness of ventral-inlay buccal mucosal graft urethroplasty for treating female urethral stricture.

METHODOLOGY

Study Design

A prospective observational cohort study.

Study Setting

The study took place at Narayan Medical College and Hospital, Bihar, India over a period of 24 months from June 2023 to June 2024.

Participants

Twenty females were comprised in the study.

Inclusion Criteria

- American Urological Association (AUA) symptom score greater than 7
- Maximum urinary flow rate of less than 12 ml/s
- Inability to calibrate the urethra with a 12 Fr Foley's catheter
- Ultrasonography showing a thick-walled/trabeculated urinary bladder with a significant postvoid residual urine (PVRU >100 ml)

Exclusion Criteria

- An abnormal focal neurological examination
- with neurogenic bladder

Sample size

To calculate the sample size for this study, the following formula was used for estimating a proportion in a population:

$$n = \frac{Z^2 \times p \times (1-p)}{E^2}$$

Where:
- n = sample size
- Z = Z-score corresponding to the desired level of confidence
- p = estimated proportion in the population
- E = margin of error

Bias

Efforts were made to minimize selection bias by strictly adhering to the inclusion and exclusion criteria. Diagnostic procedures were standardized to reduce measurement bias.

Variables

The primary variables were the AUA symptom score, maximum urinary flow rate (Qmax), and PVR. Secondary variables included the ability to calibrate the urethra and the presence of urethral narrowing on cystourethroscopy.

Data Collection

Data were gathered at baseline and during follow-up visits at 3, 6, and 12 months postoperatively. The uroflowmetry, AUA symptom score, and PVR estimation were recorded.

Procedure

To verify the diagnosis of urethral stricture, a 6 Fr 30° paediatric cystoscope (Olympus A3765A) was used for cystoscopy. With the aid of non-toothed forceps and a guidewire, the urethra was gradually opened. At six o'clock, the spongiosum and strictured urethral mucosa were cut. Bipolar cautery was used sparingly to achieve hemostasis. When the urethra was sufficiently dilated, a nasal speculum was placed. A straightened 5-0 PDS needle was used to secure the BMG to the urethra at 4 locations, preparing the urethral bed for its implantation. If further lateral stitches were required, these were taken. A 16-feet silicon Foley's catheter was inserted for compression and drainage. One month later, the catheter was taken out.

Statistical Analysis

With the use of descriptive statistics, data were examined. Mean ± standard deviation, frequencies and percentages were used variable analysis. Recurrence of symptoms, elevation of AUA symptom score, Qmax <12 ml/s, inability to calibrate the urethra with an 18 Fr catheter, and signs of urethral narrowing on cystourethroscopy were considered indicators of stricture recurrence.

Ethical considerations

The study protocol was approved by the Ethics Committee and written informed consent was received from all the participants.

RESULT

The study comprised 20 female patients with average age of 45 ± 12 years.

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All patients met the diagnostic criteria for urethral stricture. The diagnostic procedures confirmed urethral strictures, with an average preoperative Qmax of 8.5 ± 2.1 ml/s and an average PVRU of 150 ± 45 ml.

At 12 months, there was a statistically substantial improvement in the AUA symptom score, with a mean score of 18 ± 3.5 preoperatively and 4 ± 1.2 postoperatively ($p < 0.001$). At 12 months, the Qmax improved significantly ($p < 0.001$) from a mean of 8.5 ± 2.1 ml/s preoperatively to 20 ± 3.0 ml/s. After a year, the mean PVRU dropped from 150 ± 45 ml to 20 ± 10 ml ($p < 0.001$).

Three patients (15%) reported a recurrence of stricture during the 12-month follow-up, which was characterised as an increase in the AUA symptom score, Qmax <12 ml/s, inability to calibrate the urethra with an 18 Fr catheter, and/or constriction of the urethra on cystourethroscopy. Further interventions were necessary for these patients.

There were just a few minor side effects, such as moderate hematuria in four patients (20%), temporary dysuria in five patients (25%), and one urinary tract infection case (5%), which was effectively treated with antibiotics.

Pre- and post-operative values were compared in the data analysis using paired t-tests. At every follow-up period, there was a statistically considerable improvement in the AUA symptom score, Qmax, and PVRU ($p < 0.001$ for all comparisons).

Table 1: Baseline Characteristics of Participants

Variable	Value
Mean Age (years)	45 ± 12
Range (years)	25-70
Mean AUA Symptom Score	18 ± 3.5
Mean Qmax (ml/s)	8.5 ± 2.1
Mean PVRU (ml)	150 ± 45

Table 2: Post-operative Outcomes at Different Follow-Up Periods

Follow-up Period	Mean AUA Symptom Score	Mean Qmax (ml/s)	Mean PVRU (ml)
3 Months	7 ± 2	16 ± 3.2	50 ± 20
6 Months	5 ± 1.5	18 ± 2.8	30 ± 15
12 Months	4 ± 1.2	20 ± 3.0	20 ± 10

DISCUSSION

The study demonstrated that VIBMGU is an efficient and safe treatment for female urethral stricture. The procedure significantly improved the urinary symptoms and flow rates of the patients. Specifically, the AUA symptom score showed a substantial reduction from a mean of 18 ± 3.5 preoperatively to 4 ± 1.2 at 12 months postoperatively, indicating marked symptom relief. Additionally, the Qmax increased from an average of 8.5 ± 2.1 ml/s to 20 ± 3.0 ml/s, reflecting a significant improvement in urinary flow. The mean PVRU also decreased from 150 ± 45 ml to 20 ± 10 ml, showing a reduction in urinary retention.

The recurrence rate of stricture was low, with only 15% of patients experiencing recurrence within the 12-month follow-up period. These cases were managed with additional interventions. The low complication rate further supported the safety of the procedure, with minor issues such as mild hematuria and transient dysuria resolving without major interventions.

Overall, the study's results indicate that VIBMGU is a promising surgical option for women suffering from urethral stricture. The significant improvements in symptom scores, urinary flow rates, and reduction in residual urine, coupled with a low recurrence rate and minimal complications, underscore its potential as a preferred treatment method in clinical practice. These findings suggest that this technique offers substantial benefits in managing a condition that traditionally lacks well-defined treatment protocols due to its low incidence in females.

Recent studies have explored the use of VIBMGU as a treatment for female urethral stricture, focusing on its efficacy, safety, and outcomes. A study presented their knowledge with ventral onlay BMG urethroplasty for treating female urethral stricture. The procedure showed promising results, with high success rates and minimal complications. This technique is effective in managing urethral strictures and improving urinary function in women [5].

A detailed study provided a step-by-step video guide for ventral-onlay BMG urethroplasty, emphasizing its utility for female pelvic reconstructive surgeons. This educational resource aims to improve the reproducibility and understanding of the procedure among surgeons [6].

In a study of complex penile and bulbar urethral strictures, a double buccal mucosa graft technique was used successfully. The ventral-onlay approach showed good outcomes, indicating its effectiveness in treating multiple urethral strictures [7].

A case study highlighted the use of VIBMGU in a 44-year-old female with recurrent urethral stricture, demonstrating successful outcomes and improved urinary function post-surgery [8].

An initial study involving 12 women with urethral stricture disease reported a 92% success rate for ventral-inlay BMG urethroplasty, with significant improvements in urinary function and minimal recurrence of strictures [9].

A study introduced a modified ventral onlay BMG urethroplasty technique for female urethral strictures, showing high cure rates and significant improvement in urinary flow with minimal complications [10].

Generalizability

The findings of this study, which demonstrated significant improvements in urinary symptoms and flow rates following ventral-inlay buccal mucosal graft urethroplasty, suggest that this surgical intervention could be a highly effective and safe option for managing female urethral stricture on a larger scale. The marked reduction in recurrence rates and minimal complications observed in the small study sample indicate that, with larger studies and extended follow-up periods, this technique could potentially become a standardized treatment approach for a broader population of women suffering from this rare but debilitating condition. Further research with larger cohorts will be crucial to generalizing these results and refining treatment protocols.

CONCLUSION

VIBMGU significantly improved the AUA symptom score, Qmax, and reduced postvoid residual urine in female patients with urethral stricture. The procedure showed a low recurrence rate and minimal complications, demonstrating its effectiveness and safety in managing female urethral stricture.

LIMITATIONS

The limitations of this study include a small sample population who were included in this study. Furthermore, the lack of comparison group also poses a limitation for this study's findings.

RECOMMENDATION

It is advised to do more studies with bigger sample sizes and longer follow-up times in order to confirm these results and create standardised treatment guidelines for female urethral stricture.

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LIST OF ABBREVIATIONS

USD - Urethral Stricture Disease
PVRU - Postvoid Residual Urine
AUA - American Urological Association
Qmax - Maximum Urinary Flow Rate
VIBMGU - Ventral-Inlay Buccal Mucosal Graft Urethroplasty
DVIU - Direct Visual Internal Urethrotomy
BMG - Buccal Mucosal Graft
PDS - Polydioxanone Suture
Fr - French (unit for measuring catheter size)
UTI - Urinary Tract Infection

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CONFLICT OF INTEREST

The authors have no conflicting interests to declare.

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