

Role of Uroflowmetry in the Functional Evaluation of Snodgrass Urethroplasty

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ABSTRACT

Background: Snodgrass' Tubularised incised plate (TIP) urethroplasty repair has simplified the approach to distal penile hypospadias being a single-stage procedure with excellent functional results and cosmesis. But the assessment of the results of hypospadias repair remains problematic, as there exists a significant difference between the judgement of patients and operating surgeons. In order to eliminate the observer bias, we aim to establish uroflowmetry as an objective tool for the functional assessment. **Methods:** A prospective observational study was conducted during the period of November 2019 to February 2021 of all cases of Snodgrass hypospadias surgery. A total of 44 patients were included in the study and were subjected to Uroflowmetry in the pre-op and post-op (6 weeks and 12 weeks) period. Parameters studied included: Maximum flow rate (Qmax), Average flow rate (Qmean), Total voided volume, Voiding time and Type of curve. The Pre-op uroflowmetry rates were compared with those of post-op. **Results:** Out of a total of 44 children, 26 patients had coronal hypospadias while 18 had sub-coronal hypospadias. The mean age at presentation was 6yrs. Although some of the patients (n=20) presented with plateau shaped curve, at 12-weeks post urethroplasty, all the patients (n=44) were noted to have a bell-shaped curve during micturition, indicating a normal voiding pattern. Qmax at 6 weeks was noted to be reduced in 6 patients as compared with pre-op rates by an average of 20.1% (9.3%-27.7%) but at 12-weeks post-op, all the patients (n=44) were noted to have an overall increase in Qmax as compared to baseline Uroflowmetry rates. The mean increase was 23.9% (4.2%-43.1%). 2 patients were diagnosed with subclinical urethral stenosis. **Conclusion:** Uroflowmetry is a tool in the functional assessment of hypospadias surgery, objectively analysing the changes in pattern and rates. This optimizes follow up in the long-term.

Keywords: Uroflowmetry, Urodynamic studies, Snodgrass' urethroplasty, Hypospadias repair

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Introduction

Hypospadias is the result of abnormal development of penis in which there is failure of the development of urethral fold (that gives rise to the urethral meatus). Therefore, the meatus is located at the ventral penis, proximal to its normal position in glans with or without chordee.

In 1994, Snodgrass introduced the technique of urethral plate incision, tubularisation and secondary dorsal healing for Hypospadias repair [1]. Snodgrass' tubularised incised plate (TIP) urethroplasty repair has simplified the approach to distal penile hypospadias being a single-stage procedure with excellent functional results and cosmesis. But the assessment of the results of hypospadias repair remains problematic, as there exists a significant difference between the judgement of patients and operating surgeons.

Different methods have been described to objectively evaluate the results of hypospadias repair but most reports address urethral function on the basis of the presence of voiding symptoms.

In order to eliminate the observer bias, uroflowmetry has emerged as an objective tool for the functional assessment. Uroflowmetry (UF) is frequently employed in daily pediatric urology practice as a screening tool and also for diagnostic and follow-up purposes. It is an established, simple and noninvasive investigation that is used to objectively evaluate lower urinary tract dysfunction in an outpatient setting. On uroflowmetry, the maximal urinary flow rate is widely accepted as a useful parameter for assessing an individual's voiding function [2].

The flow pattern in a preoperative case of hypospadias is likely to be abnormal and can only be attributed to:

- hypoplasia of the urethra;
- insufficient spongiosal cover;
- meatal stenosis; and
- associated bladder overactivity.

The same in the postoperative period is likely to be due to noncompliance of the glans, secondary to fibrosis of stretched glans wings or meatal stenosis [3].

There is a need to study the changes in uroflowmetry rates post hypospadias repair and whether the rates may indicate a need for further surgical intervention.

Methods

A prospective observational study was conducted in the Department of Pediatric Surgery in our institution during the period of November 2019 to February 2021 of all cases of Snodgrass hypospadias surgery (aged 5 years to 12 years). The parents/guardian of all the patients with hypospadias were explained about the procedure of uroflowmetry studies and the need to perform them. Each patient was then made to undergo Ultrasound KUB (to rule out associated anomalies) followed by uroflowmetry in the pre-op and post-op (6 weeks and 12 weeks) period.

The study excluded patients having associated anomalies (neurological disorders, post bladder and bladder neck surgeries, urethral trauma, etc.), patients undergoing redo-urethroplasty, UC fistula closure and patients with poor follow-up. Parameters studied included: Maximum flow rate (Qmax), Average flow rate (Qmean), Total voided volume, Voiding time and Type of curve.

The Pre-op uroflowmetry rates were compared with those of post-op using paired-t test. For uroflowmetry, the patient was asked to pass urine in a collecting chamber of a Gravimetric Uroflowmeter (Smart Dyn Compact, Albyn Medicals), figure 1 which operates by measuring the weight of collected fluid. This is in turn connected to the computer which plots the curve according to the flow.

Results

Due to complications like urethrocutaneous fistula and the need for re-do urethroplasty, out of 51 patients, 7 children were excluded from the study. Sample size was calculated by using the formula:

$$N = (Z\alpha + Z\beta)^2 / (\text{effect size})^2$$

Where,

$$Z\alpha \text{ at } 95\% \text{ C.I one side} = 1.645$$

$$Z\beta = 0.84 \text{ at } 80\% \text{ power}$$

$$\text{Assuming Cohen's D effect size} = 0.5$$

(The sample size is calculated for matched pair, one-tailed t-test, at 95% confidence level and 80% power at moderate effect size of 0.5 and is calculated to be approximately 25. Assuming a 10% loss to follow up, the sample size is increased to 27.5 and rounded off to 30 cases of Snodgrass repair which will be followed up for 3 months).

Since this study was continued beyond the thesis study period, sample size increased to include 44 patients. Out of a total of 44 children, 26 patients had coronal hypospadias while 18 had subcoronal hypospadias. The median age at presentation was 6 years (5-12yrs). The age distribution of patients is as depicted in figure 1. Most children belonged to the age group of 5-8yrs (n=16). Pre operative uroflowmetry curves were as shown in figure 2. Although some of the patients (n=20) presented with plateau shaped curve, at 12-weeks post urethroplasty, all the patients (n=44) were noted to have a bell-shaped curve during micturition, indicating a normal voiding pattern.

Qmax at 6 weeks was noted to be reduced in 6 patients as compared with pre-op rates by an average of 20.1% (9.3%-27.7%) but at 12-weeks post-op, all the patients (n=44) were noted to have an overall increase in Qmax as compared to baseline Uroflowmetry rates. The mean increase was 23.9% (4.2%-43.1%). This was not statistically significant (p=0.496).

In 2 patients, a progressive decrease in Qmax noted at 6 weeks and 12 weeks follow up after surgery, alerted us to suspect a subclinical

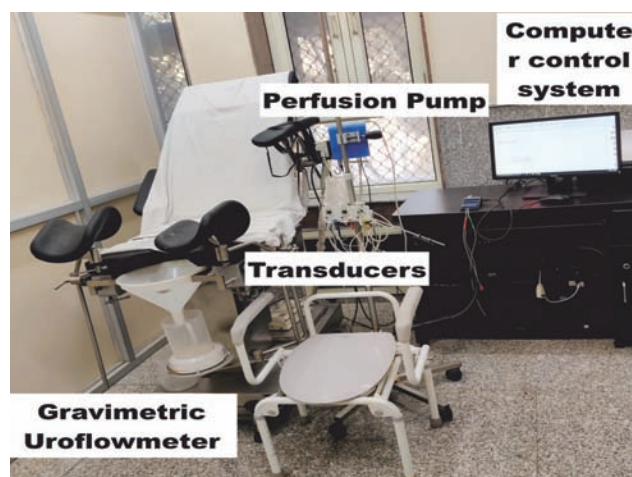


Fig. 1: Gravimetric uroflowmeter (SmartDyn Compact, Albyn Medicals)

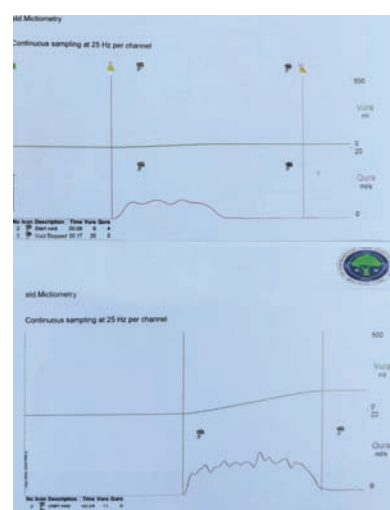


Fig. 2: Pre-op Uroflowmetry curves

urethral stenosis. These patients were then advised weekly urethral calibration and the flow improved on follow-up uroflow studies, performed at monthly intervals.

The average flow rate (Qmean) and voiding time were prolonged in patients with plateau shaped curves and staccato voiding, at presentation. Despite an overall improvement in Qmean, it depended largely on the volume of urine voided.

In terms of total voided volume, there was no significant correlation with other parameters, when using bivariate Pearson's correlation test. However, a voided volume of at least >100ml was found essential to achieve reliable flow rates.

Subjectively, Snodgrass urethroplasty showed 100% acceptance in terms of cosmesis, as confirmed with parents.

Discussion

Snodgrass introduced the concept of Tubularised incised plate (TIP) urethroplasty repair which is a technically simple, easy to learn, single-stage procedure that gives excellent short-term functional results and cosmesis almost replacing all other hypospadias repair methods. It gives a cosmetic appearance that is superior to those obtained by on lay preputial flap or flip-flap repairs.

The assessment of the results of hypospadias repair remains problematic, as published studies have shown that a significant difference might exist between the judgement of patients and operating surgeons [4].

Although functional assessment of the repair is possible by observation of the urinary stream and voiding cystourethrography, uroflowmetry is considered to be a more objective tool, especially for the detection of a subclinical urethral stenosis [5]. This was seen as a clear advantage in 2 patients in our study. Early detection of such a stenosis enabled us to intervene earlier. We subjected these patients to weekly urethral calibration and monthly follow-up with uroflowmetry until a gradually increasing trend of flow rates was ensured.

The International Children’s Continence Society recommends a maximum urination volume of less than 65% of Expected Bladder Capacity (EBC) be considered as low bladder capacity and that more than 150% as high bladder capacity. Accordingly, a maximum urine flow rate less than 10ml/sec, low mean flow rate, plateau-shaped uroflow curve and uroflow curve smaller than 5th percentile according to the nomograms in the uroflowmetry measurements are important in the evaluation of urethral obstruction [6-10].

Qmax threshold value influences the accuracy of detection of bladder outlet obstruction. Qmax variation within a single subject is not very uncommon and voided volume should preferably exceed 150 mL. To avoid errors and increase specificity, repeated measurements are useful, especially if voided volume is < 150 mL or Qmax—flow pattern is abnormal.

A Qmax < 10.6 mL/s is suggested to be associated with progression of disease and these children stand to profit from medical or surgical intervention. Jayanthi et al studied 20 patients with hypospadias aged 3 to 14 years [11]. Only 50% of the study group demonstrated flow in the normal range. They also concluded that increasing numbers of surgeries were associated with a poorer Qmax.

In our study, only 20 patients (45%) were seen to have a Qmax consistently more than 10ml/sec. The other patients did not, however, have urethral obstruction. Interestingly, these 10 patients were all more than 6.5 years of age and had a total voided volume of more than 150ml at every study. There was no significant correlation with respect to their body weight.

The shape of the urinary flow curve may be indicative of the underlying disease. Chang and Yang [12] revised the definition for the plateau curve from a previous edition of ICCS terminology to “an even flow curve with a Qmax/flow time < 0.5 without bladder over-distension”, which is preferred in practical use.

After hypospadias surgery the flow shape on uroflowmetry was observed by Hammouda [6], Kaya [13] and Anwar et. al. [14], who found that bell-shaped curves were present in 94%,82% and 80% of voids. Furthermore, these studies showed that there was a higher proportion of plateau-shaped curves compared to the normal population. In our study, we found 18 patients (40.9%) with plateau curve, 4 patients (9%) with tower shaped curves, 2 (4.5%) with staccato pattern and the rest (n=20, 45.4%) with bell shaped flow curve at presentation. At 12 weeks post-op, uroflow pattern of 42 (95.4%) patients showed a normal bell-shaped curve (Figure 3). The patients with urethral stenosis, however, maintained a plateau shaped curve almost until 24 weeks post-operatively. Comparison of pre operative and post operative uroflowmetry curves at six weeks and 12 weeks of a single patient were depicted in figure 4.

Urinary flow obstruction immediately after Snodgrass hypospadias repair may be a temporary phenomenon and the actual clinical significance of this obstruction remains unclear [10]. Indeed, in our study, Qmax dropped by an average of 20.1% in 6 patients at 6 weeks’ follow-up but eventually improved at 12 weeks’ follow-up to more than the initial (pre-op) values. Several studies conclude that early uroflowmetry after hypospadias repair is unnecessary

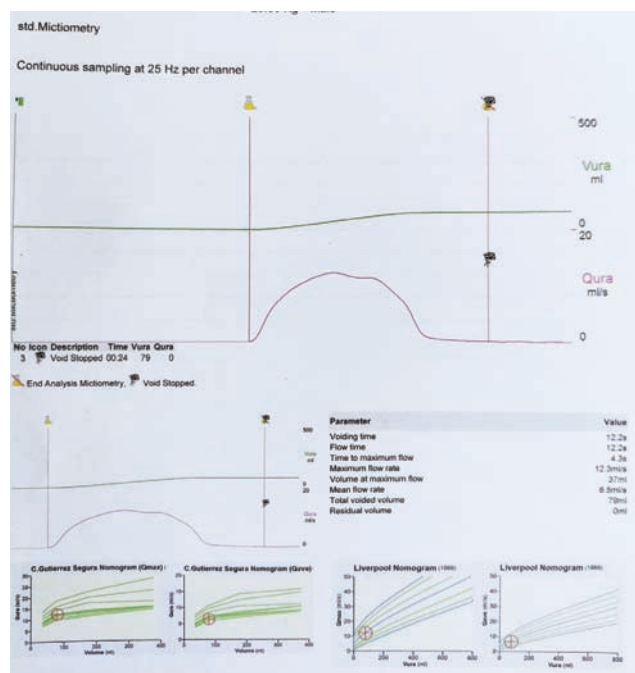


Fig.3: Post-op uroflowmetry Bell-shaped curve

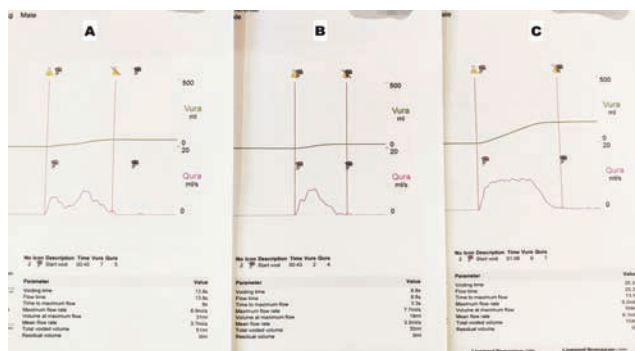


Fig. 4: Patient X Uroflow curves at (A) Pre-op (B) at 6 weeks post-op (C) at 12 weeks post-op, with progressive increase in Qmax.

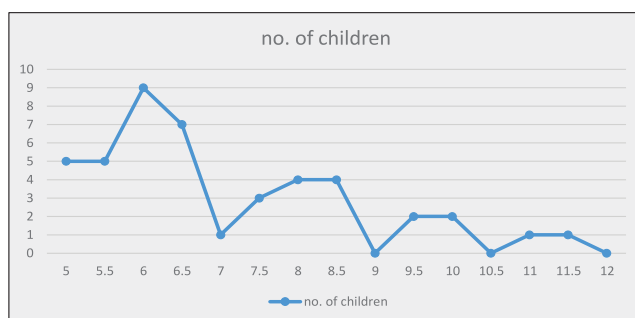


Fig.5: Line diagram showing age distribution of children included in the study

[15] but do suggest long-term follow up beyond puberty, especially in cases of proximal hypospadias. It is established that there is great potential for normalisation of urinary flow at puberty for patients treated for hypospadias with TIP urethroplasty [15,16]. Despite having limitations in the form of small sample size and short duration of follow up, we hope that this study highlights the need for uroflowmetry to assess the functional improvement and to identify complications after urethroplasty, at the earliest.

Conclusion

Uroflowmetry is a tool in the functional assessment of hypospadias surgery, objectively analysing the changes in pattern and rates.

This optimizes follow up in the long-term. Early follow up with uroflowmetry will aid in the early detection of complications. Keeping the expense and availability in mind, it may be recommended to all operated cases of hypospadias.

Key message

What is already known on this topic?

Snodgrass' Tubularised incised plate (TIP) urethroplasty for distal penile hypospadias is considered the single-stage procedure with excellent functional results and cosmesis. But the assessment of the results of hypospadias repair remains problematic, as there exists a significant difference between the judgement of patients and operating surgeons.

What this study adds?

Uroflowmetry (UF) is frequently employed in daily pediatric urology practice as a screening tool and also for diagnostic and follow-up purposes.

How this study might affect research, practice or policy?

Uroflowmetry can emerge as an objective tool for the functional assessment

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