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Research Paper

Assessing surgical outcomes in boys with symptomatic urethral meatal stenosis and lower urinary tract symptoms (LUTS)

Fadi Sawaqed [a, *], Sayel Al-Khitan [b], Mohammad Suoub [a], Obadah Tarabiah [a]

[a] Section of Urology, Department of Special Surgery, Faculty of Medicine, Mu'tah University, Jordan
[b] Section of Urology, Karak Governmental Teaching Hospital, Jordan

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ABSTRACT

Objective: The study assesses the surgical outcomes in boys with lower urinary tract symptoms (LUTS) and symptomatic meatal urethral stenosis.
Methods: This retrospective cohort study was conducted from July 2014 till December 2015. Thirty-two boys (aged 4–12 years) with Lower Urinary Tract Symptoms were examined for the presence of urethral meatus stenosis. The collected data were statistically analysed using Univariate and Multivariate analyses.
Results: A significant improvement of urinary stream, urgency incontinence, urgency, and frequency were found after using an objective assessment tool with p-value $\leq$ 0.001. The assessment of surgical outcomes, following uncomplicated meatoplasty with objective noninvasive uroflowmetry, has been reported in the pediatric population.
Conclusion: It highlighted the importance of urethral meatal stenosis diagnosis in boys with lower urinary tract symptoms. The novel contribution was made by assessing surgical outcomes following meatoplasty. However, further research is needed with larger sample cohorts.

1. Introduction

Meatal stenosis was described to be a "*pathological narrowing of the urethral opening*" [1,2]. Meatal stenosis is an under-recognized problem in the neonatal period, where symptomatic presentation increases with age and can lead to late complications [3]. Studies have shown its occurrence in more than one-fifth of the patients, who had undertaken circumcision and were asymptomatic during the neonatal period [1,4,5]. It is also observed to impact an individual quality of life and is also linked to considerable personal and societal costs [6]. A recent study reported the results of the National Hospital Discharge Survey in 2010 and depicted that almost 58% of the neonatal boys are circumcised in the neonatal hospital in contrast to 65% in 1979 [7]. Lee and Kuo [8] have stated that meatal stenosis can cause lower urinary tract symptoms (LUTS). Surgical intervention is only conducted in case of severe meatal stenosis [1,4,5]. Its clinical significance is derived from its potential outcome in urinary tract obstruction and other different complications (such as difficulty in urination, narrow high-velocity stream, urinary stream deviation, and micturition initiation pain) [9]. It may also present with obstruction, frequency, or even dysuria [4].

For treating meatal stenosis, the use of appropriate surgical or endoscopic procedures built on stricture length, anatomic position, and earlier interventions is considered to be effective [10]. It has been reported that almost 25% of patients undergo circumcision when the risk for developing meatal stenosis is high, leading to the late-onset complication of circumcision (bleeding, swelling, pain, and loss of health and functional tissues) [1,4,11]. Redness and edema might adversely affect male adolescents and can obstruct the orifice during urination [12]. More than one-fifth of the patients have been reported with meatal stenosis, who had undergone circumcision during a younger age and were asymptomatic [4]. The follow-up genital examination of boys is important, especially for those who have been circumcised to detect this condition [4]. As such, the use of meatoplasty for treating meatal urethral stenosis has been widely recognized [13].

Previous researches have recognized meatal stenosis as asymptomatic [3,4]. Since post-operative difficulties affect approximately 2–50% of male adolescents [14], therefore, its analysis is important for mitigating its adverse impact. A study highlighted that meatal in balanitis xerotica obliterans (BXO) might

* Corresponding author.
E-mail address: fadi.sawaqed@mutah.edu.jo (F. Sawaqed).

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Table 1
Symptomatic evaluation.

	1	2	3	4	5
Frequency	>Q 4 h	Q 3–4 h	Q 2–3 h	Q1-2 h	Q < 1 h
Urgency	More than 60 min	30–60 min	10–30 min	Less than 10 min	Immediate voiding
Urgency Urinary Incontinence	None	Rare Less than 1 in a month	Occasional 1–2 in a month	Often 1–2 in a week	Sever 1-2 in a day
Urinary stream	Normal	Forceful, or upward deflected	Slightly impaired or sprays	Moderately impaired, or bifid	Severely impaired, or dribbling
Nocturnal Enuresis	None	Less than 1/week	1-2/week	3-4/week	More than 5/week

cause urinary obstructions and lead to renal failure [15]. Further treatment is often necessary that includes meatoplasty, which can be considered as surgical intervention, following the preventive treatment with topical corticosteroids, when BXO is used after circumcision [16].

However, scarcity of research is found concerning the complications following meatoplasty and alleviation of severe symptoms due to meatal stenosis following meatoplasty. Therefore, to bridge this gap, the study analyzes the symptoms' severity of meatal stenosis after meatoplasty. This study has assessed the surgical outcomes among boys exhibiting LUTS and with symptomatic urethral meatal stenosis to examine the improvement in the severity symptoms. The assessment of symptoms can significantly improve and even resolve after meatoplasty. Thus, this study aims to quantitatively assess the improvement in the symptom's severity due to meatal stenosis after meatoplasty. In this regard, the following research question has been addressed:

Question: Does the severity of LUTS change after surgical intervention in patients with meatal stenosis?

2. Methodology

2.1. Study design

The study used a retrospective quantitative research design to assess the surgical outcomes among boys with symptomatic urethral meatal stenosis. All patients underwent Ventral meatotomy – suture method, i.e., all patients were circumcised. The incontinence severity index (ISI) questionnaire was used to assess the severity of incontinence symptoms among boys with symptomatic urethral meatal stenosis. This index was developed in Norway to offer a simple severity index of male incontinence for use in epidemiological surveys. The researcher has advocated its routine use as a quantitative and semi-objective measure that does not evaluate the subjective perception of a man of whether his leakage is a problem. The study was conducted in July 2014 till December 2015. The work has been reported in line with the STROCSS criteria [17].

2.2. Measures

Boys aged 4–12 years with Lower Urinary Tract Symptoms (LUT) were examined for the presence of urethral meatus stenosis. A diagnosis of meatal stenosis was conducted during the physical examination, which is explained as urethral meatus transformation in appearance with the loss of elliptical shape to a circular shape. Symptomatic evaluation for frequency, urgency, urgency incontinence, urinary stream, and nocturnal enuresis was held (Table 1). A pre and post-meatotomy was conducted to assess the LUTS. The reason for selecting nocturnal enuresis was its relatedness with the meatal stenosis.

2.3. Data collection

The questionnaire was based on two questions, which include "*How often do you experience urinary leakage?*", and "*How much urine do you lose each time?*" based on a 3-point Likert scale. The boys with symptomatic urethral meatal stenosis were included to evaluate the significant improvement in frequency, urgency, incontinence, and urinary stream. The visual assessment was described by the parents and not the clinicians, as this was a retrospective study. Also, the flow rate was not available in all urological clinics, especially in developing countries and in peripheral areas, similar to the area where the study was conducted.

The validated questionnaires were not translated nor validated in Arabic, which made the questionnaire administration difficult, due to incompetence of English language and different levels of education. For this reason, symptomatic severity was assessed during the clinical interview. The scale used was based on different LUTS assessment tools that were commonly used, which the researcher explained to the parents during the clinical interview in a simple language.

2.4. Statistical analysis

IBM Statistical Package for Social Sciences (SPSS) version 21.0 was used for analyzing the collected data. Statistical analysis was conducted using univariate and multivariate analyses. For the univariate analysis, the pre-operative and post-operative evaluations using Pillai's Trace, Wilk's Lambda, Hotelling's Trace, and Roy's Largest Root for both intercept and treatment were made. For multivariate analysis, a paired sample *t*-test was used to indicate the significant difference in the study variables. The significance level was determined at 5%. The study procedure is presented in figure (1).

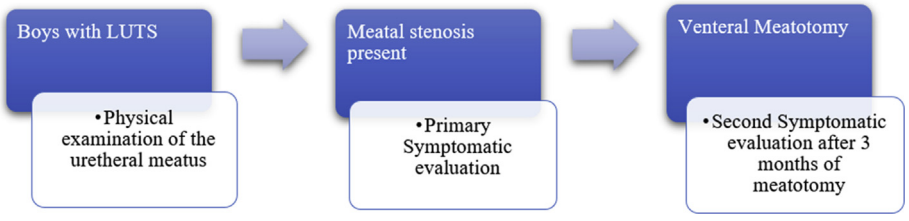

Fig. 1. Study flow chart.

Table 2
General linear model.

Effect		Value	F	Sig.
Intercept	Pillai's Trace	.989	1063.805[a]	$p \leq 0.001$
	Wilks' Lambda	.011	1063.805[a]	$p \leq 0.001$
	Hotelling's Trace	91.707	1063.805[a]	$p \leq 0.001$
	Roy's Largest Root	91.707	1063.805[a]	$p \leq 0.001$
Tret	Pillai's Trace	.933	162.527[a]	$p \leq 0.001$
	Wilks' Lambda	.067	162.527[a]	$p \leq 0.001$
	Hotelling's Trace	14.011	162.527[a]	$p \leq 0.001$
	Roy's Largest Root	14.011	162.527[a]	$p \leq 0.001$

[a] Exact statistic.

2.5. Ethical considerations

Ethical approval from the Institutional Ethical board was obtained for conducting and undertaking patients in the survey. As per institutional guidelines, an informed consent form from the guardians of the patient (aged below 18 years) was obtained for surgical intervention.

3. Results

Thirty-two patients, aged 4–12 years, were included with an average age of 7.65 and STD of 2.1. Pre-operative and post-operative evaluations were conducted by considering different dependent variables. Multivariate test was used to evaluate the significance of frequency, urgency, urge urinary incontinence (UUI), stream and nocturnal enuresis (NE); specifically described as follow:

Treat 1: Pre-operative evaluation; **Treat 2:** Post-operative evaluation.

Var 1: frequency; **S2:** urgency; **S3:** UUI; **S4:** Stream; **S5:** NE.

Multivariate analysis showed a significant improvement in the severity of all symptoms after surgery. Hotelling's value was 14.011, and $p \leq 0.001$ was observed to be less significant (p-value<0.05) (Table 2).

Univariate analysis showed significant improvement in frequency ($p \leq 0.001$), urgency ($p \leq 0.001$), urgency incontinence ($p \leq 0.001$), and urinary stream ($p \leq 0.001$). Although the improvement was noticed in nocturnal enuresis, it was insignificant (p-value of 0.068 < 0.05) (Table 3).

Symptomatic evaluation for frequency, urgency, urgency incontinence, urinary stream, and nocturnal enuresis was found significant using pairwise comparison (Table 4). The results indicated significant improvement in the severity of symptoms through the use of an objective assessment tool.

4. Discussion

This study evaluated the surgical outcomes in boys exhibiting LUTS and with symptomatic urethral meatal stenosis to alleviate the severity of symptoms following meatoplasty. Studies observed that meatal stenosis might also occur due to the ischemia of the meatal mucosa, and also stems from the frenular artery damage [9]. Ventral meatus has universally been evolved in post-circumcision meatal stenosis. Therefore, it was vital to evaluate the alleviation in the severity of symptoms following meatoplasty in boys who have symptomatic urethral meatal stenosis.

Similarly, Frisch and Simonsen [2] highlighted the prevalence of meatal stenosis by indicating that this affects 5–20% of circumcised boys and is more common in circumcised than genitally intact males. The findings have provided epidemiological evidence that circumcision eliminates the natural protection against the meatal stenosis. This is corroborated by Joudi et al. [4] study, which determined the incidence of meatal stenosis after neonatal circumcision. In it, out of 132 cases, 20.4% had severe meatal stenosis. Furthermore, hydronephrosis (pyelocaliceal) and thickening of the bladder were observed (11.4%).

The present study assessed the improvement in the degree of bother and severity of LUTS after meatotomy. The findings were drawn following the procedure to address bladder outlet obstruction. This study is the first which have objectively documented the meatoplasty outcomes among children. The assessment of surgical outcomes, following uncomplicated meatoplasty with objective noninvasive uroflowmetry, has been reported in the pediatric population. Uroflowmetry represents an objective method to assess outcomes following meatoplasty [18]. According to Godley et al. [3], there are multiple single-center observational studies with short-term follow-ups, evaluating the treatment of meatal stenosis with either meatotomy or meatoplasty. The study indicated that there was a low re-operative rate regarding re-stenosis.

Similar to it, a study has reported 0.9%–3% incidence of urethral meatus stenosis among boys [4]. Voiding cystourethrogram was also performed to disclose Vesicoureteral Reflux (VUR). Only one patient had grade II VUR in the right kidney. The results have highlighted the significance of follow-up genital examination for all male children, who have been circumcised to detect the possible meatal stenosis during the neonatal period. Another point highlighted by Frisch and Earp [12] includes that although circumcision

Table 3
Univariate analysis.

Independent Variable		Sum of Squares	Mean Square	Sig.
Frequency	Contrast	68.063	68.063	$p \leq 0.001$
	Error	33.688	.543	
Urgency	Contrast	83.266	83.266	$P \leq 0.001$
	Error	28.844	.465	
Urgency Incontinence	Contrast	76.563	76.563	$P \leq 0.001$
	Error	31.438	.507	
Urinary Stream	Contrast	92.641	92.641	$P \leq 0.001$
	Error	30.719	.495	
Nocturnal Enuresis	Contrast	1.891	1.891	p-value 0.068
	Error	34.094	.550	

Table 4
Pairwise comparisons.

Dependent Variable	Mean Difference (I-J)	Std. Error	Sig.[b]
Frequency	2.063[a]	.184	$p \leq 0.001$
	−2.063-[a]	.184	$p \leq 0.001$
Urgency	2.281[a]	.171	$p \leq 0.001$
	−2.281-[a]	.171	$p \leq 0.001$
Urgency Incontinence	2.188[a]	.178	$p \leq 0.001$
	−2.188-[a]	.178	$p \leq 0.001$
Urinary Stream	2.406[a]	.176	$p \leq 0.001$
	−2.406-[a]	.176	$p \leq 0.001$
Nocturnal Enuresis	.344	.185	.068
	−.344-	.185	.068

[a] The mean difference is significant at the .05 level.
[b] Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

presents numerous advantages, surgical complications may result. It was observed that urethral stricture and meatal stenosis present as common complications associated with BXO among children and adolescents [16]. The present study highlighted that the 35% incidence rate of this condition among circumcised males, corroborated by earlier findings of Fronczak and Villanueva [19].

As discussed earlier, there were limited studies conducted concerning investigating the surgical outcomes of treating meatoplasty in patients. This study contributes by investigating the effects of meatoplasty with meatal stenosis. However, some limitations are observed in this study. Such as the study sample recruited was small; therefore, a larger sample cohort in the future studies must be used to analyze the surgical outcomes effectively. Moreover, bowel dysfunction was not considered in the study because none of the retrospect reviewed charts have documented any bowel symptoms; all of them reported urinary symptoms. Therefore, this may also be analysed by future researches for deriving new insights into the respective discipline.

5. Conclusion

The present study evaluated the improvement of symptomatic severity in boys exhibiting LUTS and with symptomatic uretheral meatal stenosis. Using a quantitative research design, it indicated a significant improvement in the severity of LUTS following meatoplasty through an objective assessment tool. This is particularly useful when other objective tools like uroflowmetry are not available. Furthermore, it also highlights the importance of the diagnosis of uretheral meatal stenosis in boys with LUTS. It showed that it causes pain to many patients with a low degree of success rate opposite to that expected. However, clinic meatotomy could be implemented as it is directly associated with the improvements in the symptoms. It is believed that clinic meatotomy must maintain standardized care, mainly when a meatotomy treatment is used for meatal stenosis.

Ethical approval

The study has been approved by Institutional Ethical Committee at The Faculty of Medicine – Mutah University.

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Author contribution

Fadi Sawaqed: study concept or design, data collection, data analysis or interpretation, writing the paper.

Sayel Al-Khitan, Mohammad Suoub, Obadah Tarabiah: Data collection, Data interpretation.

Conflict of interest statement

The authors declare no competing interest.

Guarantor

Fadi Sawaqed.

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