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Long-term functional outcomes of distal hypospadias repair: A single center retrospective comparative study of TIPs, Mathieu and MAGPI

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Summary

Introduction
Tubularized Incised-Plate (TIP) urethroplasty is currently the preferred technique for distal hypospadias repair. Nevertheless, concerns have been raised on the long-term functionality of the reconstructed neourethra.

Objective
The aim of this study is to evaluate long-term uroflowmetry parameters' evolution after TIP surgery over a long-term follow-up including the adolescent period. TIP patients were compared to normal children using established Miskolc nomograms, as well as to patients who underwent Mathieu and Meatal Advancement and Glanuloplasty (MAGPI) surgery repairs for distal hypospadias.

Study design
Files from patients who underwent primary distal hypospadias repair at our institution between January 1, 1997 and January 31, 2001 were reviewed.

Only patients with documented serial postoperative uroflowmetry profiles at follow-up visits were included. Comparison between surgeries (TIP vs. Mathieu vs. MAGPI) was performed according to the following postoperative time interval endpoints: 0–6 months, 6–12 months, 12–24 months, 24–48 months, 4–6 years, 6–10 years and >10 years. Maximal urinary flow rate (Qmax) in relation to Voiding Volume (VV) adjusted for Age or Body Surface Area (BSA) were also evaluated in comparison to normal children using established Miskolc nomograms and compared between surgery techniques.

Results
153 patients met the inclusion criteria: 70 (43%) TIP, 24 (17%) Mathieu and 59 (35%) MAGPI. Overall, Qmax increases progressively according to time and age and in particular during the period covering adolescence with a similar trend regardless of the type of surgery. Uroflowmetry profiles in terms of Qmax, VV and PVR were equivalent between surgeries at each examined time point.

At 10 years of follow-up postopertively, mean Qmax were 17.2 ml/s, 18.8 ml/s and 21.6 ml/s respectively with no significant difference detected between groups ($p = 0.344$). Compared to normal children when adjusted for voiding volume and BSA, the proportion of obstructive uroflowmetry patterns defined as Qmax< 5th percentile of nomograms was more prevalent in patients aged 2–7 years old at 60% but decreased to less than 10%in patients aged >13 years for all procedures combined (see abstract figure) but without detected differences between surgery types ($p = 0.276$).

Discussion
After sub-optimal obstructive maximal urinary flows in the early postoperative period, hypospadias patients treated with TIP exhibit favourable long-term evolution with age and during adolescence in particular compared to normal children. In addition, a similar trend was found for patients treated with Mathieu and MAGPI with no significant differences detected between procedures.

Nevertheless, because of the relatively small sample size we cannot exclude that a statistical difference between surgeries would have been detected if the study was adequately powered on every endpoint. Nevertheless and also as suggested by the values obtained, this potential difference may be quite small and not clinically relevant.

Conclusion
These results suggest that the obstructive urinary flow pattern observed in patients early on is possibly an intrinsic feature associated to the malformation itself and may be less of a consequence of the surgical technique.

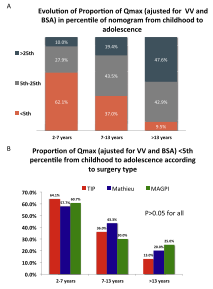

Figure A. Proportion of Qmax expressed as percentile of nomogram adjusted for VV (voiding volume) and BSA (Body Surface Area) at various age category. Data shown include all procedure combined (TIP, Mathieu and MAGPI). No differences in proportion were detected between procedures. B. Proportion of Qmax <25th percentile of nomogram according to surgery types. No difference detected between procedures.

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Introduction

As hypospadias presents with a wide spectrum of severity, a myriad of techniques have been described for reconstructive surgery. Even for a specific type such as distal hypospadias, which is the most commonly seen hypospadias defect, the variety of the procedures available remains vast and reflects the absence of an established gold standard.

In the absence of definite consensus, the choice of surgical techniques is often based on the surgeon's decision and according to personal preference. Nevertheless and according to two different surveys on current hypospadias surgery practices conducted in North America and in Europe, respectively, Tubularized Incised-Plate (TIP) urethroplasty emerges as the favored technique [1,2]. Originally described and popularized by Snodgrass in 1994, the procedure is characterized by the incision of the urethral plate that is subsequently tubularized to create the neourethra. Hence, this technique, conceptually straightforward with various technical modifications, has gained widespread acceptance as a single step procedure with low complication rates, proven satisfactory short-term functional outcomes and excellent cosmetic results [3].

However and despite its popularity, whether TIP can be considered the ideal surgery for distal hypospadias repair remains controversial [4,5]. Although without clear histological evidence, the fundamental arguments held against TIP stem from the paradigm that the ventral tissue used for the reconstruction is hypoplastic or dysplastic, thereby intrinsically lacking the properties necessary to create a satisfying functional long-term neourethra. The adherence to this concept distinguished TIP detractors who prefer to use dorsal tissues or other tissues as opposed to ventral tissues to repair the missing urethra. They also question how the incised urethral plate and ventral tissue will eventually adapt to penile growth during adolescence, with the belief that this will inevitably and negatively impact urinary functional outcomes [6–8]. Several studies have examined TIP functional outcomes using uroflowmetry with short-term and mid-term follow-up, with somewhat conflicting results [9–11]. In a meta-analysis including 11 series, obstructive flow was reported in almost a quarter of patients [12]. It has been suggested that the obstructed pattern may be attributed to the low compliance of neourethra in the absence of significant stenosis [13,14]. Interestingly, a recent report with long-term data at 7 years after TIP surgery by Andersson et al. suggested that this obstructive pattern observed at short-term follow-up resolves spontaneously [15].

To clarify these questions, the primary aim of the present study is to examine the evolution of urinary function of patients after TIP surgeries during long-term >10 years follow-up including the adolescent period. Comparative analysis with normal children was performed using a previously described nomogram. A secondary objective was to compare the evolution of uroflow parameters of TIP patients who underwent Mathieu and MAGPI procedures for distal hypospadias repair.

Material and methods

A total of 359 files from patients who had a procedure code compatible with hypospadias repair at our institution between January 1, 1997 and January 31, 2001 or were born before December 31, 1999 were reviewed, to select patients aged between 12 and 16 years old in 2013 who underwent primary hypospadias repair and had documented postoperative uroflow data. Only patients with distal hypospadias repair were included in the present study. Distal hypospadias was defined as preoperative meatal position distal to and including mid-penile shaft cases. For a total of 263 patients, 95 underwent TIP, 31 Mathieu and 137 MAGPI procedures. Some patients were excluded from the study because they had no documented uroflowmetry at follow-up postoperative visits: 25/95 = 26.3% for TIP, 7/31 = 22.6% for Mathieu and 78/137 = 61.4% for MAGPI.

Complications were defined based on the procedure that was needed to correct the defect associated with the primary surgery and according to its intervention code (dilatation for stenosis, fistula repair for fistula, etc.).

All parameters (maximum urinary flow rate [Qmax], voiding volume [VV], post void residual [PVR], age and weight) were collected prospectively from patients' files and representative data gathered at routine follow-up visits. Uroflow parameters were assessed when children were toilet trained. Children were encouraged to drink fluids before and asked to void whenever normal desire or urge to void was present during the visit. The uroflowmeter (Urocap, LABORIE, Toronto, Canada) is located in a quiet and private room similar to a normal toilet. The flow rate was considered valid if the voided volume was more than 50 ml. Residual urine was measured using ultrasound within 5 min, and expressed as a percentage of VV.

BSA was calculated using the DuBois and DuBois formula. Uroflowmetric parameters were assessed using a calibrated electronic uroflowmetry system, and PVR was measured using bladder ultrasound. Qmax expressed in ml/s and PVR expressed as a percentage of total VV were used for comparison of voiding profiles. Comparison between surgeries (TIP vs. Mathieu vs. MAGPI) was performed for all parameters (time, age, Qmax, PVR) at each of the following postoperative time endpoints: 0–6 months, 6–12 months, 12–24 months, 24–48 months, 4–6 years, 6–10 years and >10 years. In addition, Qmax in relation to VV and adjusted for BSA, was evaluated against established Miskolc nomograms referred to by the standardization committee of the International Children's Continence Society (ICCS) in three different age groups: 2–7 years, 7–13 years and >13 years old. Various nomograms have been described establishing the relationship between Qmax and VV. The equation of this particular nomogram was also chosen because its curve is situated between the various curves representative of the previously described nomograms in children. Furthermore, this nomogram takes into account age or BSA in addition to VV. Patients with Qmax falling below the 5th percentile were considered to have obstructive flow.

All statistic calculations were performed using IBM SPSS statistics software. All parameters were tested for normality using the Kolmogorov–Smirnov test. Continuous variables that were normally distributed were expressed as mean and standard deviation. Accordingly, postoperative Qmax, age and time were compared using one-way ANOVA test for each parameter at each time point. Alternatively, median and range were used to express data that did not fit normal distribution and median was compared using the