ORIGINAL ARTICLE

Six-Year Retrospective Analysis of MIP Hypospadias: Clinical Traits, Complications, and Patient Satisfaction

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ABSTRACT

Background: This study aims to evaluate the clinical characteristics, complications, and patient satisfaction associated with the MIP hypospadias variant. Additionally, it seeks to highlight the unique clinical manifestations observed in our hospital compared to other studies.
Methods: We conducted a retrospective analysis of 31 patients with MIP who were admitted to our hospital between January 2008 and February 2023. Before writing this article, all patients were contacted via telephone for follow-up, and a satisfaction survey was completed by the patients and their families. The retrospective analysis encompassed clinical data such as age, meatal position, and penile curvature, type of surgical repair, complications, and results from the satisfaction survey.
Results: The average age of the 31 patients with MIP was 92.1 ± 40.7 months, with a median follow-up period of 49.0 [21.0-82.2] months. Among these patients, 21 (67.7%) exhibited ventral curvature, while no cases of dorsal curvature were observed. The patients were categorized into two groups: those with curvature and those without curvature. Significant differences were noted between these groups in terms of age (80.4 ± 41.6 vs. 117.0 ± 26.0 months) and weight (22.7 [15.8-35.0] vs. 45.0 [32.0-46.0] kg). During the follow-up period, six children experienced postoperative complications, though none required reoperation. The primary risk factors for complications were the position of the meatus and whether urethroplasty was performed. Complications appeared to be the only factor affecting patient satisfaction.
Conclusions: MIP hypospadias variants often present with significant ventral curvature. Surgical intervention generally yields favourable outcomes with a low rate of complications. Key concerns for patients and their parents include achieving a good skin appearance and adequate correction of curvature.
Keywords: MIP, curvature, complications, satisfaction, children
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INTRODUCTION

Megameatus intact prepuce (MIP) is a rare variant of hypospadias, with an estimated incidence of about 1 in 10,000, accounting for 1% to 3% of all hypospadias cases.[1] However, the precise incidence remains unclear as some patients never seek medical attention[2]. MIP was first identified by Juskiewenski et al. in 1983, and later, Duckett and Keating elaborated on its characteristics and introduced the "pyramid procedure" as a surgical treatment option[3,4].

Despite several retrospective studies, there is a notable gap in the literature regarding comprehensive research that includes large sample sizes, extensive clinical data, long-term follow-up and patient satisfaction surveys. Additionally, the issue of penile curvature in MIP patients has been inconsistently addressed, with some studies reporting differing conclusions from our hospital's observations. Therefore, this article aims to examine the clinical characteristics, complications, and patient satisfaction associated with the MIP hypospadias variant, and to highlight the unique clinical manifestations observed

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in our hospital compared to other studies.

METHODS

We conducted a retrospective analysis of 37 patients with MIP admitted to our hospital from January 2008 to February 2023, excluding those who had previous surgeries elsewhere. The meatal position was categorized into gland, coronal sulcus, and distal penis. Follow-up was scheduled at six months post-surgery and annually thereafter. Prior to this study, all patients participated in a telephone follow-up, and satisfaction surveys were completed by the patients and their families. This study was approved by hospital ethical committee no; IEC/SKIMS-224/2022.

Clinical data assessed included age, meatal position, penile curvature, type of repair for both hypospadias and penile curvature, complications, and satisfaction survey results. Surgical methods included meatal advancement and glanuloplasty (MAGPI), tubularized incised plate urethroplasty (TIP), Duckett, Mathieu, circumcision, and penile curvature straightening. Patients were divided into the urethroplasty group (TIP, Duckett, Mathieu, and MAGPI) and the non-urethroplasty group (circumcision and penile curvature straightening). Postoperative infection prevention involves cephalosporin antibiotics. For urethroplasty procedures, catheters were maintained for 8 to 10 days, whereas for penile curvature correction without urethral formation, catheters were left for 5 to 7 days. No catheter was required for circumcision alone. Curvature was diagnosed using an artificial erection test during surgery with saline injection after penile skin degloving. The degree of curvature was measured with a protractor, and if greater than 15 degrees, correction was performed. For ventral curvature between 15 and 30 degrees, plication sutures with polypropylene 4.0 were used. For curvature greater than 30 degrees affecting the urethra, urethral plate transection was considered.

Statistical analysis was performed using R software (version 4.0.3, http://www.r-project.org). Continuous data not following normal distribution were reported using the median and interquartile range and analyzed by the Mann-Whitney U test. Chi-square or Fisher exact tests were used to compare variables between groups. Statistical significance was set at $P<0.05$.

RESULTS

From 2018 to 2024, 37 patients were diagnosed with the MIP hypospadias variant out of 7,782 hypospadias cases treated surgically at our hospital. Six patients were excluded due to loss of follow-up, leaving 31 patients with complete clinical data and telephone follow-up, resulting in a 16.2% loss to follow-up rate. The average age of these 21 patients was 92.1 ± 40.7 months, with a median follow-up time of 49.0 [21.0-82.2] months. Of the 21 MIP patients, 21 (67.7%) exhibited ventral curvature following the artificial erection test performed during surgery. No cases of dorsal curvature were observed. Based on the presence of curvature, patients were divided into two groups: those with curvature and those without. The curvature group had a significantly lower average age (80.4 ± 41.6 months) compared to the no curvature group (117.0 ± 26.0 months) ($P<0.01$). The median weight was also significantly different, with the curvature group at 22.7 [15.8-35.0] kg and the no curvature group at 45.0 [32.0-46.0] kg ($P=0.02$). In the curvature group, 14 had their urethral openings in the glans, 6 in the coronal sulcus, and 1 in the distal penis. In the no-curvature group, these numbers were 4, 6, and 0, respectively, with no statistically significant difference between the groups ($P=0.23$). All patients in the curvature group underwent curvature correction, including 8 cases of degloving. Among these, 12 required dorsal plication due to persistent curvature, and one severe case necessitated urethral plate transection. None of the patients in the no curvature group required these procedures. Refer to Figure 1 for more details.

Complications and Treatment

Post-operative complications occurred in 6 children (19.4%), but none required reoperation. The complications included 2 cases of adherent prepuce, 2 urethral strictures, 1 small urethral diverticulum, and 1 instance of glans dehiscence caused by accidental forceful catheter removal by the patient. Of the urethral stricture cases, one was resolved by reinserting the catheter and delaying its removal by 2 months post-surgery. In the other case, the parents reported a thin urine stream, but there was no difficulty in urination, and the condition did not worsen. This patient is currently under continuous observation, and surgical intervention is deemed unnecessary at this time.

Analysis of Complications and Satisfaction

Patients were categorized into two groups: those without complications (N=25) and those with complications (N=6),

as presented in Table 2. The only statistically significant differences between the two groups were observed in the position of the urethral opening and satisfaction rate (P<0.05). No significant differences were found in age, weight, duration of hospital stay, preoperative diagnosis, circumcision history, surgical procedure, presence of curvature, straightening methods, or urethroplasty (P>0.05).

Satisfaction Survey

A satisfaction survey revealed that 85.7% of parents and patients with penile curvature expressed satisfaction with the surgical outcomes, compared to 90.0% in the group without curvature, with no statistically significant difference (P>0.05). Figure 2 illustrates that out of 21 children with curvature, 13 underwent urethroplasty, with a satisfaction rate of 76.9%, while the remaining 10 cases had a satisfaction rate of 100%, showing no significant difference between the groups (P=0.26). Intraoperatively, 23 cases of abnormal urethral openings were identified, with 8 being detected preoperatively. Satisfaction rates at follow-up were similar, with 87% satisfaction among intraoperative diagnoses and 87.5% among preoperative diagnoses, showing no statistically significant difference (P=1.00).

DISCUSSION

In 1983, Juskiewenski et al. initially described MIP as a form of "anterior hypospadias," characterized by a meatus positioned at the base of the glans or within the balance-preputial groove, without significant chordee(3). Despite existing studies on MIP, several unresolved issues persist, including the propensity for curvature, distinctions in complication rates compared to typical hypospadias cases, and factors influencing patient satisfaction post-surgery. To address these gaps, we conducted a comprehensive review of clinical data from MIP surgical cases over the past 15 years at our institution to offer valuable insights for readers. In a retrospective analysis, Ben-David et al. examined 118 MIP cases with a median age at repair of 1.1 years, reporting curvature in 24% of patients, predominantly dorsal (19%) rather than ventral (5%). Conversely, in our study, no dorsal curvature was observed, while 67.7% (21/21) of patients presented with ventral curvature. This discrepancy may be attributed to several factors:

Neonatal Circumcision and Age at Surgery: In Ben-David's study, all MIP patients underwent circumcision neonatally, possibly influencing subsequent curvature development[5]. In contrast, our patients, mostly uncircumcised until school age, underwent surgery later, minimizing the impact of circumcision-related skin changes. This suggests a potential link between dorsal curvature and skin deficiency.

Undiagnosed MIP: Patients with curvature underwent surgery at a younger age compared to those without curvature (80.4 ± 41.6 vs. 117.0 ± 26.0 months). Observing meatal position in uncircumcised children may be challenging, with ventral curvature more noticeable due to urinary symptoms, prompting earlier medical attention. Conversely, dorsal curvature, discernible only during erection, may go unnoticed by older children, complicating diagnosis.

Table 1: Clinical characteristics of patients with and without curvature

	No curvature (N=10)	Curvature (N=11)	*p*-value
Age (m)	117.0±26.0	80.4±41.6	<0.01
Weight (Kg)	45.0 [32.0-46.0]	22kg [15.8-35.0]	0.02
Urethral opening position			0.23
Glans	4 (40.0%)	7 (66.7%)	
Coronal sulcus	6 (60.0%)	3 (28.6%)	
Distal penis	0	1 (4.76%)	
Degloving	-	4 (38.1%)	
Degloving+ DP	-	6 (57.1%)	
UPT	-	1 (4.8%)	
Urethroplasty	6 (60.0%)	7 (61.9%)	1.00
Satisfaction survey	9 (90.0%)	9 (85.7%)	1.00

DP: Dorsal Plication; UPT: Urethral plate Transection

Ligamentous Structural Forces: Ozbey proposed that dorsal glans curvature in MIP patients results from a deficient lower median septum and predominant distal ligament traction. He stressed the importance of assessing these structural elements[6]. Moreover, in our cohort, 61.9% (13/21) of patients with severe ventral curvature required dorsal plication or urethral plate transection, suggesting complex pathophysiology beyond typical curvature mechanisms.

Moreover, within this patient cohort, 6 individuals underwent dorsal plication, and one patient required urethral plate transection due to severe ventral curvature, constituting 61.9% (13/21) of all patients with ventral curvature. This indicates that the ventral curvature in these cases surpassed 30 degrees. Consequently, we posit that, unlike dorsal curvature, the presence of severe ventral curvature implies the involvement of additional factors warranting exploration in understanding abnormal penile development among MIP patients. This underscores the necessity for further investigation into the underlying mechanisms contributing to severe ventral curvature in MIP cases. This study encompassed both skin and urethral complications in its analysis, identifying only the position of the meatus and the performance of urethroplasty as risk factors for postoperative complications. Over a median follow-up period of 49.0 [21.0-82.2] months, none of the 9 patients undergoing TIP surgery experienced fistula formation. In contrast, Snodgrass et al. reported only one case of postoperative urethral fistula among 63 patients undergoing TIP surgery, suggesting low complication rates in such procedures[7]. While previous literature suggests neonatal circumcision doesn't heighten complications in MIP treatment, our case revealed the necessity for urethral plate transection due to severe curvature, emphasizing circumcision termination as a viable option in suspected penile anomalies. Pieretti et al. also believed that prior circumcision did not negatively affect the results of the MIP variant of hypospadias[8]. During telephone follow-up assessing patient and parental satisfaction, simplified inquiries about penile function and appearance facilitated cooperation, particularly among older children. Interestingly, complete correction of urethral position didn't significantly impact satisfaction. Instead, concerns centred on postoperative complications, residual penile curvature, and skin appearance, underscoring the importance of achieving aesthetically pleasing outcomes alongside functional improvement. The study's 0.4% MIP incidence over 15 years aligns with satisfaction survey results,

Table 2: Risk factors for postoperative complications

	No complications (N=14)	Complications (N=6)	Total (N=21)	*p*-value
Age (m)	92.3±38.7	91.1±52.2		0.96
Weight (Kg)	28.1 [17.8-43.1]	35.5 [17.4-45.6]		0.92
Hospital stay (d)	5.6±3.3	7.5±4.7		0.39
Intraoperative diagnosis	11 (76.0%)	4 (66.7%)	16 (74.2%)	0.63
Circumcision history	2 (12.0%)	0	2 (9.7%)	1.00
Surgery methods：				0.06
Circumcision	3 (20.0%)	0		
Straightening	4 (28.0%)	0		
MAGPI	4 (28.0%)	1 (16.7%)		
TIP	3 (20.0%)	4 (66.7%)		
Duckett	0	1 (16.7%)		
Mathieu	1 (4.0%)	0		
Urethral opening position				0.03
Glans	10 (68.0%)	1 (16.7%)		
Coronal sulcus	4 (32.0%)	4 (66.7%)		
Distal penis	0	1 (16.7%)		
Curvature	10 (68.0%)	4 (66.7%)	14 (67.7%)	1.00
Urethroplasty	7 (52.0%)	6 (100%)	13 (61.3%)	0.06

indicating that many MIP patients without curvature opt against surgical intervention to preserve functionally unaffected mega meatus.

CONCLUSIONS

MIP hypospadias variants may present with severe ventral curvature, while the aetiology of dorsal curvature warrants further investigation. Surgical interventions demonstrate favourable outcomes with a low complication rate. However, achieving optimal skin appearance and effective curvature correction remain primary concerns for patients and parents alike.

Statements and Declarations

Ethics Approval and Consent to Participate: This study was approved by hospital ethical committee no; IEC/SKIMS-224/2022. Patients and parents, being informed about potential research use of clinical data with assured privacy protection, provided informed consent. The study adhered to the Declaration of Helsinki guidelines and received approval from the ethics committee of Beijing Children's Hospital.

Consent for Publication: Not applicable.

Availability of Data and Materials: The datasets utilized and analyzed during the study are available from the corresponding author upon reasonable request.

Competing Interests: None of the contributing authors declare any conflicts of interest.

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Authors' Contributions:

- Raashid Hamid: Protocol development, Data collection, Data analysis, Manuscript writing, Participation in surgical treatment.
- Faheemul Hassan, Ajejaz A Baba, Shoib Ahmad (Co-first Author): Protocol development, Data collection, Data analysis, Participation in surgical treatment.
- Akshit Sudanshu,Sabina Nisar, Vivek Sharma, Ubayer Nabi, Gowhar N Mufti, Ajaz A Baba,
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