

Hypospadias scoring challenges: a pilot study on GMS interpretation

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Received: 03/10/2024

Accepted: 21/10/2024

Published: 05/12/2024

Cite this article: Atasever HE, Bahadır GB, Sürer İ. Hypospadias scoring challenges: a pilot study on GMS interpretation. *Surg Child.* 2024;1(4):84-88.

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ABSTRACT

Aims: Hypospadias is one of the most common urological congenital anomalies. Several scoring systems have been established to create a common language for hypospadias because the severity, determined only according to meatus localisation, does not provide an accurate approach. Glans-urethral meatus shaft (GMS) scoring is one of them.

Methods: This pilot study's purpose was to determine how to improve the GMS score (3-12) and if it would be beneficial to divide the three-part structure (mild, moderate, severe) into two groups: high and low scores. Our study was planned and conducted as a one-year prospective study, and 44 cases were included in this study.

Results: Conventional groups were regrouped as the low score group, including GMS 3-7 scores, and the high score group, including GMS 8-12 scores. High score group was statistically significantly higher than low score group regarding the presence of complications ($p=0.021$). No significant correlation was found between glans and penis measurements and development of complications.

Conclusion: Our study suggests that the simpler two-category method we proposed for the evaluation of the GMS score may also be an alternative. It suggests the need for further studies to evaluate and improve the utility of all scoring methods, including the GMS.

Keywords: Hypospadias, classification, score, complication, outcomes

INTRODUCTION

Hypospadias is one of the most common congenital anomalies in boys in which the external urethral meatus is located more proximal than where it should be. The ventral curvature of the penis, developmental defects of the corpus spongiosum, and incomplete prepuce comprise the other components of the presenting anomaly. The assessment of the severity of birth defects can sometimes be quite difficult, and this can be even more complicated in the case of hypospadias. Estimating the severity of hypospadias based solely on the location of the external urethral meatus often leads to inaccurate assessments. There are many factors-such as penis length (PL), glans width (GW), adequacy or shape of the foreskin, penoscrotal changes, degree of curvature, degree of torsion of the penis, urethral plate width (UP) and depth of the urethral groove-used for evaluating the hypospadias.¹⁻⁴ Many scoring methods also have been developed to determine the severity of hypospadias. The motivation for these attempts was the fact that none of the previous classifications could fully describe the degree of the

condition and were inadequate in predicting postoperative possible complications. When we look at all the existing scoring methods today, it is seen that there is no consensus on a scoring system.⁵⁻⁷

Hypospadias scoring involves complex parameters. Considering the need for a common language of hypospadias, many scoring systems have been developed to make this challenging situation more manageable, including anatomical meatus localisation and different features, one of which is the Glans-Urethral Meatus Shaft (GMS) score (Table 1).^{8,9}

The moderate group in the conventional classification is not clearly separated from the mild and severe groups. This grouping method is thought to create difficulties in the surgical approach and evaluation of results. This study aimed to investigate how the GMS score could be improved and whether there would be any advantage in reorganising the three-part structure (mild-moderate-severe) into only two groups, high and low scores.

**Table 1.** GMS scoring sections and criteria**Glans (G) score**

1. Glans good size; healthy urethral plate, deeply grooved
2. Glans adequate size; adequate urethral plate, grooved
3. Glans small in size; urethral plate narrow, some fibrosis or flat
4. Glans very small; urethral plate indistinct, very narrow or flat

Meatus (M) score

1. Glanular
2. Coronal sulcus
3. Mid or distal shaft
4. Proximal shaft, penoscrotal

Shaft (S) score

1. No chordee
2. Mild ($<30^\circ$) chordee
3. Moderate ($30-60^\circ$) chordee
4. Severe ($>60^\circ$) chordee

GMS: Glans-urethral meatus shaft scoring

METHODS

This study was approved by the local ethics committee of the Gülhane Training and Research Hospital, Clinical Researches Ethics Committee (Date: 02.03.2022, Decision No: 2022/25). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

We designed this study prospectively by including the patients who would undergo primarily hypospadias surgery after obtaining institutional ethical committee approval and informed consent preparation. We excluded the patients (8 cases) who had undergone circumcision or hypospadias surgery before starting the study. A tubularised incised plate urethroplasty (TIPU) procedure was performed in all cases. In most cases, degloving was sufficient for the straightening of the chordee. All surgical procedures were performed by a single surgeon. A total of 44 paediatric hypospadias cases were included in our study at the end of one year. The age, duration of hospital stay, operation time, GMS scores, GW, UP, PL, and meatus distance (MD) were recorded. The measurement variables were obtained manually and with the help of callipers while the patient was on the operating table just before the operation. Operation time was calculated as the time between incision and dressing. All adverse outcomes which developed during the follow-up period were recorded and categorised as complications. To determine the UP measurement, the widest points of the UP were evaluated horizontally on the glans held stretched before any incision. After the GMS score was obtained, it was grouped conventionally as mild, moderate, and severe. An ROC analysis was applied for the statistical discrimination of the reduction of the GMS grouping to two classes (low score, high score) instead of three (mild, moderate, severe). Accordingly, it was seen that the GMS score had an AUC (Youden index) of 83.6% with a cut-off value (7.50). Thus, scores between 3-7 and between 8-12 were determined as groups. Then the moderate part of the group was taken out and regrouped as only low score (LS) and high score (HS).

The many tests were applied to the statistical analysis. Shapiro-Wilk ($n < 50$) and Skewness-Kurtosis tests were used to determine whether the continuous measurements in the study were normally distributed and parametric tests were applied since the measurements were normally distributed. Independent T-test and One-way Analysis of Variance (ANOVA) were used to compare the measurement values according to categorical

groups. Following the variance analysis, the “Duncan test” was used to determine the different groups. The chi-square test was calculated to determine the relationship between categorical variables. The statistical significance level was taken as $p < 0.05$ and the SPSS (IBM SPSS for Windows, ver.26) statistical package program was used for the analyses.

RESULTS

The mean age (months) of 44 paediatric cases included in the study was 52.14 ± 36.01 . The mean duration of hospital stay (day) of the cases was 9.68 ± 5.52 . The mean follow-up period (months) was 9.7 ± 5.62 . The mean PL (mm) was 24.25 ± 5.75 . The mean GW (mm) was 13.91 ± 3.23 . The mean MD (mm) was determined as 8.14 ± 4.94 . The mean UP (mm) was 6.2 ± 1.8 (Table 2).

Table 2. Means and standard deviations (SD) of continuous variables

	Mean	SD	Min.	Max.
Age (months)	52.14	36.01	13	145
Duration of hospital stay (days)	9.68	5.52	2	27
Follow-up period (months)	9.7	5.62	2	23
Penis length (mm)	24.25	5.75	13	41
Glans width (mm)	13.91	3.23	10	23
Meatus distance (mm)	8.14	9.94	4	70
Urethral plate width (mm)	6.2	1.87	3	10
Operation duration (minutes)	105	44.28	40	300
Glans score	2.39	1.04	1	4
Meatus score	2.18	0.79	1	4
Shaft score	2.09	0.91	1	4
GMS score	6.66	2.24	3	12

Min: Minimum, Max: Maximum, GMS: Glans-urethral meatus shaft

It was determined that the mean Glans score was 2.39 ± 1.04 , the mean Meatus score was 2.18 ± 0.79 , and the mean Shaft score was 2.09 ± 0.91 . The mean total GMS score is 6.66 ± 2.24 . Complications occurred in 12 of 44 cases (27.20%). These complications (Clavien-Dindo 2-3) were fistula in 7 cases, infection in 2 cases, meatal stenosis in 2 cases, and dehiscence in 1 case. There were 23 cases with a GW of 14 mm and above. The number of cases with UP of 8 mm and above was 12. The age and duration of hospital stay in complicated cases were 70 ± 41.39 months and 12.75 ± 6.66 days, respectively. These variables were statistically significantly higher in complicated cases than in uncomplicated cases ($p = 0.042$ and $p = 0.022$, respectively). the Glans score and the Meatus score were statistically significantly higher in complicated cases ($p = 0.001$ for the Glans score and $p = 0.002$ for the Meatus score). These variables were 3.42 ± 0.67 and 2.75 ± 0.62 , respectively. The Shaft score was 2.33 ± 1.07 and did not lead to a statistically significant difference in complicated and uncomplicated cases ($p = 0.285$). GMS score was 8.50 ± 1.78 in complicated cases and 5.97 ± 2.01 in uncomplicated cases. GMS score was detected statistically significantly higher in complicated cases than in uncomplicated cases ($p = 0.001$) (Table 3). When GW was considered as a categorical variable, the number of cases with a GW of 14 mm or above was 23, 6 of which were complicated cases. In cases with GW below 14 mm, 6 of 21 cases were complicated. Thus, it was found that GW above and below 14 mm did not create a statistically significant difference in terms of complications ($p = 0.853$). Similarly, when the UP is taken as a categorical variable, the number of cases with a UP of 8 mm or more is 12, with 2 being complicated cases. In cases with a UP of less than 8 mm, 10 of 32 cases were complicated. Hence, it was found that UP above and below 8 mm did not cause

**Table 3.** Comparison results of variables according to the presence of complications

	Complicated		Non-complicated		*p
	Mean	SD	Mean	SD	
Age (months)	70	41.39	45.44	31.95	0.042
Duration of hospital stay (days)	12.75	6.66	8.53	4.63	0.022
Follow-up period (months)	11.75	5.05	8.94	5.7	0.141
Penis length (mm)	24.33	6.56	24.22	5.53	0.954
Glans width (mm)	14.33	3.85	13.75	3.03	0.600
Meatus distance (mm)	8.67	3.96	7.94	11.46	0.831
Urethral plate width (mm)	6.08	1.73	6.25	1.95	0.796
Operation duration (minutes)	113.75	36.38	101.72	47	0.429
Glans score	3.42	0.67	2	0.88	0.001
Meatus score	2.75	0.62	1.97	0.74	0.002
Shaft score	2.33	1.07	2	0.84	0.285
GMS score	8.5	1.78	5.97	2.01	0.001

*: Significance levels according to independent T-test results, SD: Standard deviation, GMS: Glans-urethral meatus shaft

Table 4. Statistical outcomes of GMS score groups according to the presence of complications

		Complicated		Non-complicated		*p
		n	%	n	%	
Conventional grouping	Mild GMS 3-6	1	4.50	21	95.50	0.001
	Moderate GMS 7-9	7	41.20	10	58.80	
	Severe GMS 10-12	4	80.00	1	20.00	
Recommended grouping	vs.					0.021
	Low score GMS 3-7	5	16.70	25	83.30	
	High score GMS 8-12	7	50.00	7	50.00	

*: Statistical significance level according to chi-square results, GMS: Glans-urethral meatus shaft

a statistically significant difference in terms of complications ($p=0.333$). According to the presence of complications, there was a statistically significant difference between the groups when GMS scores were grouped only as LS (cases with 3-7 points) and HS (cases with 8-12 points). HS was statistically significantly more likely to have complications ($p=0.021$). Also, a statistically significant difference was observed in the conventional grouping (mild, moderate, severe) according to the presence of complications (**Table 4**).

DISCUSSION

In some other studies, the mean age was lower and there was no statistically significant difference. In many articles in the literature, the mean age is lower than in our study. But, in similar studies conducted in Turkey, higher mean age is found more frequently. Whether the attitude of caregivers or the health policy approach causes this is worthy of further research.^{8,10-12} A shorter hospitalisation period was expected however, the fact that patients were not discharged with a catheter in our centre or caregivers' hesitation for post-operative care may have caused this situation. In various other studies, complication rate was found to be 14.1%, 18%, and 28.6%. Among these studies, the complication rates of the studies that mostly included proximal hypospadias cases were higher.^{8,13-15}

UP is one of the parameters used in predicting results and decision-making in hypospadias surgery. There is no statistically significant difference with UP according to the presence of complications, both as a continuous variable and as categorised for 8 mm. Statistical significance was found in some studies, but not in others. Variations in measurements may have been effective in these differences; in some studies, the widest part of the UP was taken while in others the width at the midline of the glans was taken.¹⁶⁻²⁰

However, in some studies, glans size was statistically significant, while in others it was not. Factors such as the age of the patients and preoperative hormone use may be causally associated with this difference.²¹⁻²³ GMS is a scoring system that determines the severity of hypospadias with four points from each section and 12 points in total. Inter-observer reliability tests of GMS scoring have been performed previously, this test has no measurement data and provides practical facilities. It has been in clinical use as a simple hypospadias assessment tool. The three sections are the G score, which evaluates the glans, the M score, which evaluates the meatus, and the S score, which evaluates the shafts. In addition to GW in the G score, the UP and the urethral groove condition are evaluated in the same line. In fact, in a previous study by Arlen et al.⁸ the higher value was chosen when there were controversies about these different parameters that coexist in the G score. Sometimes, these problems were avoided by considering only the GW.^{8,9,24,25}

The conventional grouping method that assesses the severity of hypospadias into three categories: mild, moderate, and severe leads to some challenges. Firstly, the concept of severity of hypospadias is susceptible to misinterpretation (for example, when multiple parameters within the Glans score can lead to discrepancy results, resulting in minor score variations from moderate to severe). The second problem is that if the scoring systems have a moderate group, designed for practical decision-making, forces the surgeon to take the initiative in deciding for cases within the moderate group. Our research addresses these challenges and suggests modifying the grouping system by reducing it from three groups to two which makes the definition clear. This revised approach highlights the distinction between LS and HS groups without emphasising focusing on the severity of the condition.^{16,21,22,26}

After obtaining the GMS score, all cases are grouped as mild, moderate, and severe. GMS and similar scores, which



are created to increase preoperative decision-making and predictions about postoperative results, may cause a relatively difficult situation for the surgeon because they contain an unclear moderate group.^{8,27} Although the shaft score portion of GMS has been associated with complication as an independent variable in some previous studies, it has been seen that there is no relation between shaft score and the presence of complication in our study ($p=0.285$). Other studies suggesting that the glans score can be divided into glans and urethra sections (Glans-Urethra-Meatus-Shaft scoring) have also been included in the literature. Our suggestion is a simplified scoring system in which the surgeons' approach and hypospadias results can be evaluated more simply rather than GUMS or similar systems.^{8,28}

A previous study reported that a GMS score above 6 increased the risk of surgical complications. According to the grouping we recommended in this study, the complication rate was 16.5% ($n=5$) in the LS (GMS 3-7) group and 50.0% ($n=7$) in the HS (GMS 8-12) group (Table 4).

Limitations

The most prominent limitation of this study is the small number of participants and short follow-up time. In the future, prospective studies with more participants may provide even more valuable and detailed insights into similar issues.

CONCLUSION

GMS is one of the most practical scoring systems that can effectively evaluate hypospadias. However, it should not be ignored that there are deficiencies in this scoring system. It seems that the simpler two-group method we proposed for the interpretation of the scoring may be an alternative in terms of ease of use. All these results demonstrate the need for a common language on hypospadias as well as the need for an objective system for the correct approach.

ETHICAL DECLARATIONS

Ethics Committee Approval

This study was approved by the local ethics committee of the Gülhane Training and Research Hospital, Clinical Researches Ethics Committee (Date: 02.03.2022, Decision No: 2022/25).

Informed Consent

Written informed consent was obtained from the parents of all patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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