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A RETROSPECTIVE ANALYSIS OF MATHIEU AND TIP URETHROPLASTY TECHNIQUES FOR DISTAL HYPOSPADIAS REPAIR; A 20 YEAR EXPERIENCE

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Summary.- *OBJECTIVE: We aimed to identify the changes in the application rate of two surgical techniques in distal hypospadias repair in years and compare the most popular two surgical repair techniques for distal hypospadias in terms of surgical outcomes, the factors that affect the outcomes, which were performed over a 20 year period.*

METHODS: In this study, the records of 492 consecutive patients that had undergone an operation for distal hypospadias in the urology clinic of Ankara between May 1990 and December 2010 using either Mathieu or TIPU surgical techniques were reviewed retrospectively. The patients who had glanular, coronal, and subcoronal meatus, were accepted as distal hypospadias cases. Among the 492 examined medical records, it was revealed that 331 and 161 surgical interventions were performed by using the Mathieu urethroplasty technique (Group-1) and TIP urethroplasty technique (Group-2), respectively. Group-1 was divided into two subgroups; namely Group-1a (patients with primary hypospadias) and Group-1b (patients with previous hypospadias operation). Likewise, Group-2 was divided into two subgroups; namely group-2a and group-2b. The patients' ages, number of previously urethroplasty operations, localization of the external urethral meatus prior to the operation, chordee state, length of the newly formed urethra, whether urinary diversion was done or not, post-operative complications and data regarding the follow-up period were evaluated, and the effects of these variables on the surgical outcome were investigated via statistical analyses. The primary objective of this study is to identify the changes in the application rate of two surgical techniques in distal hypospadias repair over the a 20 year period, and the secondary objectives are to compare the most popular two surgical repair techniques for distal hypospadias in terms of surgical outcomes, and the factors affecting the outcomes. Independent samples t test and Pearson's Chi-square test was used for statistical analysis. $p<0.05$ was considered as statistically significant.

RESULTS: There were no statistically significant differences between the subgroups in terms of age, length of the neo-urethra, number of previously performed urethroplasty operations, surgical success rates, or complications ($p>0.05$). The concurrent utilization of the cystostomy and urethral stent was significantly more frequent in group-1 ($p<0.05$; Pearson's Chi-square test). It was determined that over time, TIP urethroplasty has become a more preferred technique for the repair of distal hypospadias.

CONCLUSIONS: Both surgical techniques have similar success rates in distal hypospadias cases. TIP urethroplasty has become the method of choice over time.

Keywords: *Distal hypospadias. Mathieu urethroplasty. TIP urethroplasty.*

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Resumen.- *OBJETIVO: Identificar los cambios en la tasa de aplicación de dos técnicas quirúrgicas en la reparación del hipospadias distal durante los años, y comparar las dos técnicas más populares de reparación quirúrgica del hipospadias distal realizadas durante 20 años en términos de resultados quirúrgicos y los factores que afectan a los resultados.*

METODOS: En este estudio revisamos retrospectivamente las historias clínicas de 492 pacientes consecutivos intervenidos por hipospadias distal en la clínica urológica de Ankara entre mayo de 1990 y diciembre de 2010 utilizando las técnicas de Mathieu o TIP. Los pacientes que tenían un meato glandular, coronal o subcoronal se aceptaron como casos de hipospadias distal. Entre los 492 casos, 331 fueron intervenidos con la técnica de Mathieu (Grupo 1) y 161 con la técnica de Uretroplastia TIP (Grupo 2). El grupo 1 se subdividió en dos subgrupos: Grupo 1a (pacientes con hipospadias primario) y Grupo 1b (pacientes con historia de hipospadias intervenido previamente). Igualmente, el Grupo 2 se subdividía en dos subgrupos: Grupo 2a y Grupo 2b. Se evaluaron las edades de los pacientes, el número de uretroplastias previas, la localización del meato uretral externo antes de la operación, el estado de la corda, la longitud de la uretra nuevamente formadas, si se hizo derivación urinaria o no, las complicaciones postoperatorias y los datos relativos al periodo de seguimiento, y se hizo análisis estadístico de los efectos de estas variables en los resultados de la cirugía. El objetivo primario del estudio es identificar los cambios en la tasa de aplicación de las dos técnicas quirúrgicas con los años, y los objetivos secundarios comparar las dos técnicas de reparación del hipospadias distal más populares en términos de resultados quirúrgicos, factores que afectan a los resultados; técnicas que fueron realizadas a lo largo de 20 años. Para el análisis estadístico se utilizaron el test de la t para muestras independientes y el test del Chi cuadrado de Pearson. Se consideró una p>0,05 como estadísticamente significativa.

RESULTADOS: No había diferencias estadísticamente significativas entre los subgrupos en términos de edad, longitud de la neouretra, número de uretroplastias previas, tasa de éxitos o complicaciones (p>0,05). La utilización concomitante de cistostomía y stent uretral fue significativamente más frecuente en el grupo 1 (p<0,05; test del Chi cuadrado de Pearson). Se determinó que con el tiempo la Uretroplastia TIP se había convertido en la técnica más preferida para la reparación del hipospadias distal.

CONCLUSIONES: Ambas técnicas quirúrgicas tienen tasas de éxito similares en los casos de hipospadias distal. La Uretroplastia TIP se ha convertido con el tiempo en el método de elección.

Palabras clave: *Hipospadias distal. Uretroplastia de Mathieu. Uretroplastia TIP.*

INTRODUCTION

Hypospadias is an anomaly, characterized by the immature development of the anterior urethra and ectopic localization of the urethral meatus proximally on the ventral side of the penis. When hypospadias is classified according to the localization of the external meatus, the most common type among the population is subcoronal hypospadias. The treatment for hypospadias is surgical, and although the basic principles are the same, various techniques have been described for the repair of distal hypospadias. The common purpose in most surgical techniques is to achieve a near-normal penis both functionally and cosmetically.

In this study, we retrospectively evaluated the medical records of patients that had undergone either perimeatal-based flap (Mathieu) urethroplasty or TIP urethroplasty for distal hypospadias repair between the years 1990-2010. The TIP urethroplasty became popular after it was defined by Snodgrass in 1994 (1,2). We aimed to identify the changes in the application rate of two surgical techniques in distal hypospadias repair with time, over a 20 year period, as primary objective and to compare the two most popular surgical repair techniques for distal hypospadias in terms of surgical outcomes and factors affecting the outcomes as secondary objectives. Surgical success rates, and complications for each technique were compared.

MATERIALS AND METHODS

The records for the 504 consecutive patients that had undergone an operation for distal hypospadias in the urology clinic of Ankara between 1st May 1990 and 1st December 2010 using either Mathieu or TIPU surgical techniques were reviewed retrospectively.

Participants, Variables and Measures

There were 492 patients included in the study and 12 patients excluded due to loss of follow-up or incomplete charts. The patients who had glanular, coronal, and subcoronal meatus were accepted as distal hypospadias cases, and they were included in the study. The patients who had a previous history of failed hypospadias repair in other centers were included in the study. The patients that had undergone

re-do hypospadias repair in our clinic with either TIPU or Mathieu techniques, were excluded in order to prevent recurrent patient evaluation.

Among the 492 examined medical records, it was revealed that 331 and 161 surgical interventions were performed by using the Mathieu urethroplasty technique (Group 1) and the TIP urethroplasty technique (Group 2) respectively. Group 1 was divided into two subgroups; namely group 1a (patients with primary hypospadias) and group 1b (patients with previous hypospadias operation). Likewise, Group 2 was divided into two subgroups; namely group 2a and group 2b.

Comparisons between group 1a and group 1b, group 2a and group 2b, group 1a and group 2a, group 1b, and group 2b were made. The groups were compared for patients' ages, number of previous urethroplasty operations, length of neo-urethra (was measured by a ruler during the surgery), chordee state, the surgical method used for the correction of chordee (if it was corrected), the type of diversion used, and complications at the early postoperative period, as well as surgical outcomes.

Surgical Technique and Follow-up

The surgical team consisted of four staff members and residents, and all interventions were made by a staff member and a resident. All naive cases were done by the resident under supervision of a staff member. All the patients were administered with a single dose intravenous ampicillin at 100 mg/kg dosage prior to their operation, and an oral antibiotic treatment was administered for seven days following the operation. Penile chordee was evaluated with an artificial erection of penis after degloving. The magnification usage was not regularly recorded on the charts.

TIP urethroplasty was performed as defined by Snodgrass. A surgical marker was used to line a U shape around the urethral plate an external meatus. After degloving, the glanular wings were prepared and the plate was incised. Starting from the meatal base, urethroplasty was performed with the continuous suturing technique using 6/0 polyglycolic acid or 6/0 polydioxanone suture materials. The suture line was covered by a dartos flap layer.

Mathieu urethroplasty, urethral plate was measured and perimeatal based flap was lined with a surgical marker. After degloving of the penis and preparation of the glanular wings, incision of the flap was performed. Flap was laid on the urethral plate. Starting from the meatal base, urethroplasty was performed with the continuous suturing technique from both sides using 6/0 polyglycolic acid or 6/0 polydioxanone suture materials. The suture lines were covered by a dartos flap layer.

Skin repair was made with 4/0 or 5/0 polyglycolic acid suture material. Either an 8-14 Fr polyethylene feeding tube or suprapubic cystostomy catheter together with a polyethylene feeding tube were used for the urinary diversion, as appropriate with the patient's age and native proximal urethral calibre. Bipolar electrocautery was used to control bleeding intraoperatively. The length of the neo-urethra was determined by measuring the distance between the old and the new meatus using a ruler, and was expressed in millimeters.

At the end of the operation, all patients' penises were dressed first with a single layer of antibiotic wrapping, then with a piece of damp cotton wool, a dry sponge, and lastly with compression bandages. The surgical dressings were removed from all patients on postoperative day 4. Urethral stents and, if present, cystostomy catheters were withdrawn on the 7th day, and the patients were allowed to urinate.

Control of each patient was done as follows; examination of the location and appearance of the new external urethral meatus, existence of any urethrocutaneous fistula, visual examination of urination. The patients who developed urethrocutaneous fistula or in whom the formed tube was opened were accepted as unsuccessful cases. After voiding, the patients were re-evaluated at the control visits scheduled on the 10th day, and the 1st, 6th and 12th months. The records of the follow-up times for the patients varied between 1 to 12 months (median 3 months).

This study was approved by the ethics committee at the Ankara Training and Research Hospital.

Statistical Analysis

SPSS for Windows 15.0 software was used for statistical analysis. The normality of the distribution was analysed with the Kolmogorov-Smirnov and Shapiro-Wilk tests. The Skewness and Kurtosis values were also measured. The *Independent samples t-test* was used to determine if there were differences between the subgroups regarding patients' ages, and number of previous operations, as well as to compare the length of the neo-urethras. To compare surgical success, the presence of chordee, urinary diversion methods, and complications between the subgroups,

Table I. Ages of the patients and number of previous operations among groups.

	Count	Age (Years)			Number of previous operations		
Operation type	**(n)**	**min.**	**max.**	**Mean ± SD**	**min.**	**max.**	**Mean ± SD**
Group-1	331						
Group-1a	254	1.5	30	8.74 ± 4.93			
Group-1b	77	1	30	9.71 ± 4.99	1	4	2.65 ± 0.82
Group-2	161						
Group-2a	107	1	26	7.76 ± 5.06			
Group-2b	54	1	34	10.26 ± 5.41	1	4	2.52 ± 0.72
p*				0.09			-
p^				0.55			-
p§				-			0.34

p Comparison of group-1a and 2a in terms of patients' age*
p^ Comparison of group-1b and 2b in terms of patients' age
p§ Comparison of group-1b and 2b in terms of the number of previous operations

the *Pearson's Chi-square test* was used. $p<0.05$ was considered as statistically significant.

RESULTS

Data regarding patients' ages and the number of previous operations is presented in Table I. In group-1, there were a total of 331 patients, group-1a and group-1b consisted of 254 and 77 patients, respectively. In group-1b, the number of previous hypospadias surgeries were as follows: 44 secondary, 16 tertiary, and 17 quaternary. In group 2, there were a total of 161 patients. Group 2a and group 2b consisted of 107 and 54 patients, respectively. In group 2b, the number of previous hypospadias surgeries were as follows: 33 secondary, 14 tertiary, and 7 quaternary. There were no statistically significant differences between the subgroups in terms of patients' ages ($p=0.09$ and $p=0.55$, neither in the comparison of group 1a and 2a, nor group 1b and 2b, respectively. *Independent t-test*), and the number of previous operations ($p=0.34$, and the comparison of group 1b and 2b, respectively. *Independent t-test*) (Table I).

Table II. Lengths of the neo-urethra.

	Count	Length (mm.)		
Operation type	**(n)**	**min.**	**max.**	**Mean ± SD**
Group-1	331			
Group-1a	254	5	40	1.41 ± 0.53
Group-1b	77	8	30	1.78 ± 0.54
Group-2	161			
Group-2a	107	5	30	1.34 ± 0.44
Group-2b	54	10	30	1.61 ± 0.52
p*				0.23
p^				0.08

p, independent t-test, comparison of group-1a and group-2a*
p^, independent t-test, comparison of group-1b and group-2b

The data regarding the length of neo-urethra among the groups are presented in Table II. There was no statistically significant difference between group 1a and 2a (p=0.23) in terms of the length of the neo-urethra, and between group-1b and 2b (p=0.08).

There was no differences between the subgroups regarding the presence of penile chordee (Group 1a and 2a, group 1b and 2b, *p=0.27 and p=0.11*, respectively. *Pearson's Chi-square test*). There were 17 and 13 patients with penile chordee in group 1a and group 1b, respectively. Surgical correction with dorsal plication was performed in one patient in group-1a, and three patients in group 1b. In the remaining 26 patients, a skin incision and dissection of the paraurethral fibrotic tissue was enough for the correction of chordee for both subgroups. There were four and four patients with penile chordee in group 2a and group 2b, respectively. Surgical correction with dorsal plication was performed in one patient in group 2b. In the remaining 7 patients, a skin incision and dissection of the paraurethral fibrotic tissue was enough for the correction of chordee for both subgroups.

When the subgroups were compared in terms of surgical success, no statistically significant differences were observed (The comparison of group 1a and 1b, group 2a and 2b, p=0.14 and p=0.36, respectively. The comparison of group 1a and 2a, group 1b and 2b, *p = 0.50, p = 0.80, Pearson's Chi-square test, respectively*) (Table III).

When the groups were compared in terms of the urinary diversion method, the combination of urethral stent and cystostomy was significantly more frequent in group 1 than in group 2 (*Pearson's Chi-square test, p = 0.00*).

When the frequencies of both operation techniques were analyzed within the five-year periods, it was determined that over time, the TIP urethroplasty had become a more preferred method (Figure 1).

There were no differences between the subgroups (p=0.09 and 0.63. *Pearson's Chi-square test*, comparison between group 1a versus group 2a and group 1b versus group 2b) in terms of postoperative complications (Table IV). In our study groups, we did not encounter any complications higher than grade II according to the Clavien classification.

DISCUSSION

Hypospadias is one of the most common congenital anomalies. Its prevalence in European countries is 3 in every 1000 live births (3). In cases where there is a familial history of hypospadias, this rate can increase up to 1 in every 100 male births (4). Eighty percent of the cases have distal hypospadias. In the past, cases with hypospadias with coronal or subcoronal localization were not treated as these did not have a problem in urinating or having children; however, these cases are treated now thanks to the advances in surgical techniques and materials. Hypospadias is treated by means of the surgical repair of the anatomical defect. Targeted outcomes of hypospadias operations mainly bring the external meatus onto the glans, a correction of urinary stream projection, achieving a cosmetic appearance satisfactory to both the patient and surgeon, and correction of penile curvature if present.

There are various repair techniques that yield successful results in cases of distal hypospadias. The complication rates in these techniques are quite low

Table III. Comparison of surgical success in subgroups according to number of operations and operation techniques.

		Result					
Treatment		**Successful n (%)**	**Unsuccessful n (%)**	**Total**	**p***	**p****	**p*****
Group-1	Group-1a	227 (89.4)	27 (10.6)	254	0.14	0.50	0.80
	Group-1b	64 (83.1)	13 (16.9)	77			
Group-2	Group-2a	93 (86.9)	14 (13.1)	107	0.36		
	Group-2b	44 (81.5)	10 (18.5)	54			

p>0.05, Pearson's Chi-square test. Comparison of success within the subgroup 1a-1b and 2a-2b*
p^>0.05, Pearson's Chi-square test. Comparison of success within the subgroup 1a-2a
p§>0.05, Pearson's Chi-square test. Comparison of success within the subgroup 1b-2b

(5). The main reason for this is that the length of the neo-urethra in the cases with distally located hypospadias is short, and there is a sufficient amount of adequately vascularized tissue to form and support this length of urethra. Mathieu urethroplasty, a perimeatal-based flap technique, has been extensively performed in distal hypospadias cases since 1932; the year it was first described. It is not only performed in primary hypospadias cases, but also in cases undergoing re-operation (6). The presence or absence of preputium, the shape of the glans, and the depth of the sulcus have no significance in the Mathieu urethroplasty technique. The presence of a double suturing line may increase the risk of fistula development, whereas for long flaps, a reduction of the blood flow at the distal end may increase the risk of meatal stenosis.

The TIP urethroplasty technique was first described by Rich et al., and was modified by Snodgrass (7,8). The technique involves the dorsal vertical incision of the urethral plate as to allow the tension-free tubularization of the new urethra; the incision does not affect the tissue blood flow, and it heals in a short time without any scar. In this way, a neo-urethra is formed around an 8-12 Fr urethral catheter, and a vertical appearing meatus is obtained. Since this technique imitates the normal embryological closure of the urethra, a more physiological appearance of the penis is achieved with this technique compared to other surgical techniques. We have been performing TIP urethroplasty in our clinic since 1996, and over time it has become the most frequently used technique in the treatment of distal hypospadias cases (Figure 1).

Table IV. Complications observed in groups.

Clavien-Dindo	Group-1 (n) Early Postop (<30 days)	Group-1 (n) Late Postop (>30 days)	Group-1 (n) Total (n)	Group-2 (n) Early Postop (<30 days)	Group-2 (n) Late Postop (>30 days)	Group-2 (n) Total (n)
Grade-I	8	-	8	2	-	2
Grade-II	1	-	1	3	-	3
Grade-III						
III-a	4	1	5	3	1	4
III-b	40	-	40	24	-	24
Grade-IV	-	-	-	-	-	-
Total	53	1	54	32	1	33

Complication	Treatment Group-1 (n=331)(%)	Treatment Group-2 (n=161)(%)	Total (n)
Stent expulsion	4 (1%)	3 (1.8%)	7
Complete opening of the tube	2 (0.6%)	1 (0.6%)	3
Meatal stenosis	1 (0.3%)	1 (0.6%)	2
Bladder irritation sign	1 (0.3%)	2 (1.2%)	3
Preputium edema	5 (1.5%)	1 (0.6%)	6
Skin necrosis	0 (0%)	1 (0.6%)	1
Urethrocutaneous fistula	38 (11%)	23 (14.2%)	61
Cystostomy come away	2 (0.6%)	1 (0.6%)	3
Hematoma	1 (0.3%)	0 (0%)	1
Total	54	33	87

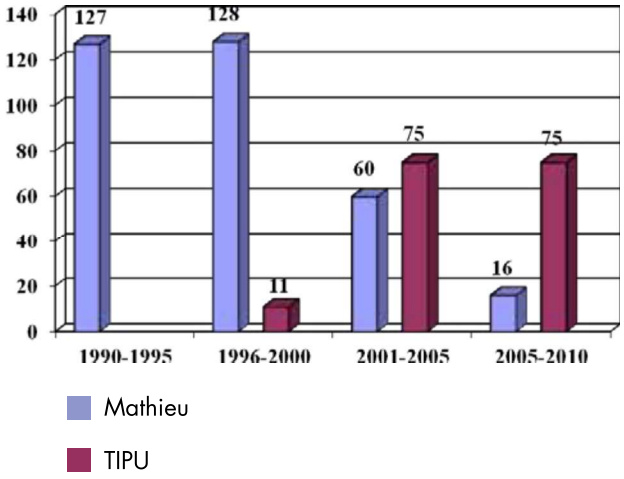

Figure 1. Frequency of operation techniques by years.

The transverse appearance of the meatus formed with the Mathieu technique has been a significant drawback in this technique; especially after the introduction of TIP urethroplasty (5). Besides the adequate diameter of the newly formed meatus, achieving an anatomically normal vertical appearance is also important in hypospadias repair. While the meatus appears horizontal and round in Mathieu and onlay island flap techniques, normal vertical appearing meatus is achieved with the Snodgrass technique (7). This is one of the reasons for the increasing preferability of this method over the last 20 years. Recently, modified Mathieu techniques that obtain a slit like meatus have been described (8).

Eleven percent of the distal hypospadias cases may have penile chordee (9). For a successful surgical outcome, penile chordee should be corrected if it is present. In our series, the frequency of penile chordee in a total of 361 primary hypospadias cases was 5.8% (*n=21*). In the distal hypospadias cases, the ventral chordee can be corrected by degloving the penis, but orthoplasty may be required if it cannot be corrected this way. Dorsal plication was performed in 0.3% of group 1a where ventral chordee had been detected prior to the operation, but could not be corrected after the penis was degloved and paraurethral fibrotic tissues were dissected. In group 2a no dorsal plication was needed after penile degloving.

Following TIP and Mathieu urethroplasty, the requirement of a urethral stent time was reported as 2 to 10 days (9,10). One study compared the surgical outcomes in cases with and without catheters after the repair operation of the distal hypospadias with metal-based flaps, and since the complication rates were determined to be high in cases without catheters, it was recommended to use one about 3 to 5 days after the operation (11). There are also studies that do not recommend the utilization of catheters following Mathieu urethroplasty (12). The insertion of the urethral catheters prevents urinary extravasation, and thereby facilitates re-epithelization. Our clinical practice is to remove the urethral catheter on the 7th postoperative day, and to make the patient void. We abandoned the practice of diversion with a urethral stent and suprapubic cystostomy, which we had used frequently in the past, because suprapubic cystostomy does not make a significant contribution in the surgical success.

Various complications can arise following hypospadias surgery, some of which are meatal stenosis, fistula development, and urethral stricture. The reported complication rates after hypospadias surgery vary between 0 to 22% (13-16). In our series, the complication rates were 16.3% and 20.5% for group 1 and group 2, respectively. The reason why we have such high complication rates is that these rates do not only account for complications such as meatal stenosis, urethral stricture, complete opening of the tube, and urethrocutaneous fistula, but all the complications that we encountered (Table IV). Additionally, the re-operated cases were also included in this series, which is another reason for the high complication rates. Both surgical techniques have high success rates in the distal hypospadias cases. Our success rates in group 1a and group 2a are 89.4% and 86.9%, respectively, and the success rates in group 1b and group 2b are 83.1% and 81.5%, respectively.

Meatal stenosis and urethrocutaneous fistula development can be observed following both surgical techniques. In Mathieu urethroplasty, the distal ends of the flaps that are longer than 2 cm in length may have nourishment problems, and this can lead to meatal stenosis (15, 17). The length of the flap can be made over 2 cm by keeping the base of the flap wide (18). If urethrocutaneous fistula is related to meatal stenosis, the fistula may close spontaneously after dilating the obstruction at an early period. If it does not close in this way, the fistula should be repaired 6 months later (19). Studies report the urethrocutaneous fistula development rates after TIP urethroplasty as 2% to 17% (9,14). In our series, urethrocutaneous fistula development rates for group 1a and group 2a were 10.2% and 13.0%, respectively. These rates for group 1b and 2b were 15.5% and 16.6%, respectively.

For the hypospadias cases that require a re-operation, disturbed vascularization of the penile tissues and preformed scars may affect the success

of the later operation. There are studies related to the utilization of both TIP urethroplasty and Mathieu urethroplasty in distal hypospadias cases that require re-operation. Some studies report that success rates for both operations in re-operated distal hypospadias cases are lower than the rates obtained from the operations of the primary cases using the same techniques (20). It has been stated that the complication rates might increase in the recurrent meatal-based flap methods due to the previous hypospadias repair surgery that resulted in disturbed vascularization of the dartos layer (21). There are studies which report that both surgical techniques can be successfully used on re-operated patients (21,22). In our study, the success rates in the primary patients were higher in both groups, but we did not find a significant difference between the success rates in the primary patients and re-operated patients in both groups. The operations on the primary cases were mostly performed by residents with a staff urologist, but the operations on the non-primary cases were mostly performed by the staff urologists. This may be an explanation for this situation.

CONCLUSION

There is no difference between the success rates in both surgical techniques between the subgroups for the distal hypospadias cases. Over time, TIP urethroplasty has become the method of choice in distal hypospadias cases because this technique provides a more physiological external urethral meatus and glans appearance. Both surgical techniques have high success rates in distal hypospadias cases that require a re-operation. For the non-primary cases of distal hypospadias, treatment by experienced staff might reach the success rates of the primary cases.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

ETHICAL APPROVAL

This study was approved by the ethics committee at the Ankara Training and Research Hospital.

"All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study formal consent is not required."

REFERENCES AND RECOMMENDED READINGS

1. Snodgrass WT, Bush N, Cost N. Tubularized incised plate hypospadias repair for distal hypospadias. J Pediatr Urol 2010; 6:408-13.
2. Ferro F, Vallasciani S, Borsellino A, Atzori P, Martini L. Snodgrass urethroplasty: grafting the incised plate--10 years later. J Urol 2009;182:1730-4.
3. Caione P. Prevalence of hypospadias in European countries: is it increasing? Eur Urol 2009;55:1027-9.
4. Morera AM, Valmalle AF, Asensio MJ, Chossegros L, Chauvin MA, Durand P, et al. A study of risk factors for hypospadias in the Rhône-Alpes region (France). J Pediatr Urol 2006;2:169-77.
5. Snodgrass W, Bush N. TIP hypospadias repair: A pediatric urology indicator operation. J Pediatr Urol 2016;12:11-8.
6. Mathieu P. Treitement en un temps de l'hypospadias balanique et juxta-balanique. J Chir 1932;39: 481.
7. Snodgrass W. Tubularized, incised plate urethroplasty for distal hypospadias. J Urol 1994;151: 464-65.
8. Hadidi AT. The slit-like adjusted Mathieu technique for distal hypospadias. J Pediatr Surg 2012;47:617-23.
9. Snodgrass WT, Bush N, Cost N. Tubularized incised plate hypospadias repair for distal hypospadias. J Pediatr Urol 2010;6:408-13.
10. Daher P, Khoury A, Riachy E, Atallah B. Three-week or one-week bladder catheterization for hypospadias repair? A retrospective-prospective observational study of 189 patients. J Pediatr Surg 2015;50:1063-6.
11. Busson H, Smiley D, Reinberg Y, Gonzalez R. Distal hypospadias repair without stents: Is it better? J Urol 1994;151: 1059-60.
12. Hakim S, Merguerian PA, Rabinovitz R, Shortliffe LD, McKenna PH. Outcome analysis of the modified Mathieu hypospadias repair: comparison of stented and unstented . J Urol 1996;156: 836-8.
13. Fahmy O, Khairul-Asri MG, Schwentner C, Schubert T, Stenzl A, Zahran MH et al. Algorithm for Optimal Urethral Coverage in Hypospadias and Fistula Repair: A Systematic Review. Eur Urol, 2016;70:293-8.
14. Stehr M, Lehner M, Schuster T, Heinrich M, Dietz HG. Tubularized incised plate (TIP) urethroplasty (Snodgrass) in primary hypospadias repair. Eur J Pediatr Surg 2005;15:420-4.

15. Hueber PA, Antczak C, Abdo A, Franc-Guimond J, Barrieras D, Houle AM. Long-term functional outcomes of distal hypospadias repair: A single center retrospective comparative study of TIPs, Mathieu and MAGPI. J Pediatr Urol 2015;11:68.
16. Retik AB, Mandell J, Bauer SB, Atala A. Meatal based hypospadias repair with the use of a dorsal subcutaneous flap to prevent urethrocutaneous fistula. J Urol 2000;152:1229-31.
17. ElGanainy EO. A modified onlay island flap vs. Mathieu urethroplasty for distal hypospadias repair: A prospective randomised study. Arab J Urol 2015;13:169-175.
18. Sorber M, Freiz WFJ, de Vires JDM. Short and midterm outcome of different types of one-stage hypospadias corrections. Eur Urol 1997;32:475-79.
19. Sunay M, Dadali M, Karabulut A, Emir L, Erol D. Our 23-Year Experience in Urethrocutaneous Fistulas Developing After Hypospadias Surgery. Urology 2007;69:366-8.
20. Nozohoor Ekmark A, Svensson H, Arnbjörnsson E, Hansson E. Failed hypospadias repair: An algorithm for secondary reconstruction using remaining local tissue. J Plast Reconstr Aesthet Surg 2015;68:1600-9.
21. Safwat AS, Elderwy A, Hammouda HM. Which type of urethroplasty in failed hypospadias repair? An 8-year follow up. J Pediatr Urol 2013;9:1150-4.
22. Nguyen MT, Snodgrass WT, Zaontz MR. Effect of urethral plate characteristics on tubularized incised plate urethroplasty. J Urol 2004;171:1260-2.