



Separation of the glanular part of the urethral plate, mobilization of the distal part of the neourethra, and creation of the glanular groove: a new modification of second-stage Thiersch–Duplay urethroplasty in proximal hypospadias repair

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Abstract

Purpose To evaluate the effect of separation of the glanular part of the urethral plate from the underlying glans penis with creation of a glanular groove for free accommodation of the neourethra as a new modification of Thiersch–Duplay urethroplasty in proximal hypospadias repair.

Patients and methods Between January 2016 and January 2022, 35 patients with proximal hypospadias underwent a modified Thiersch–Duplay two-stage procedure. The glanular portion of the urethral plate was either separated from the underlying glanular tissue or discarded if found scared with mobilization of the distal portion of the neourethra to reach the tip of the glans penis. In all patients, a few millimeter of glanular tissue is excised to create a glanular groove in which the neourethra is embedded freely.

Results 35 patients were involved in this study. The patient's age at the time of operation ranged from 18 months to 10 years (median 3.7 years). The mean follow-up period was 15.7 months (ranging from 12 to 18 months). Two patients developed urethrocuteaneous fistula; while, none of the patients had meatal stenosis, urethral stricture, or meatal retraction. All patients have a slit-like meatus at the tip of the penis and a good cosmetic conical shape glans appearance.

Conclusion We believe that in Thiersch–Duplay urethroplasty, separation of the urethral plat from the underlying glanular tissue and creation of good glandular groove to accommodate the neourethra is associated with adequate glanular closure and minimization of post-operative meatal stenosis, glanular dehiscence, and meatal retraction.

Keywords Hypospadias · Thiersch–Duplay · Urethral mobilization · Hypospadias surgery

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Introduction

Hypospadias is a common congenital condition with an incidence of 3.2 per 1,000 live births [1]. In 20% of cases, the abnormal urethral meatus is proximal penile, penoscrotal, scrotal, or perineal.

A variety of surgical techniques have been described for reconstruction of the urethra in proximal hypospadias that may be performed either in a single stage or in two stages [2, 3].

Thiersch–Duplay principle is the technique in which the neourethra is created by tabularizing the urethral plate. Since its invention by Thiersch in 1869, and Duplay in 1873, it has been widely accepted and practiced by many surgeons for treatment of proximal hypospadias and represents the basic foundation for all surgical methods that utilize the urethral plate to construct a urethral tube [4].

The main complications of Thiersch–Duplay procedure in the reported series are urethrocuteaneous fistula, stricture formation, glans dehiscence, and meatal retraction [5, 6]. To decrease the reported complications, a number of Thiersch–Duplay modifications were invented to improve its results; however, in spite of those modifications, meatal stenosis and meatal retraction are still encountered complications of second-stage Thiersch–Duplay urethroplasty [6].

In this study, we reported a new modifications for the second stage of Thiersch–Duplay urethroplasty to improve the results of meatal stenosis and meatal retraction complications.

Patients and methods

Between January 2016 and January 2022, 35 patients underwent surgical treatment for proximal hypospadias. A modified Thiersch–Duplay two-stage procedure was performed in all patients. In the first stage, under general anesthesia, the penis was examined with an artificial erection to evaluate the degree and extent of the penile chordae. Correction of penile curvature was performed by excision of the fibrous urethral plate on the ventrum of the penis up to the tunica albuginea of the corpora cavernosa. Any residual curvature after excision of the chordae was corrected by dorsal plication. Following release of chordae, a preputial skin flap was created, and rotated ventrally to cover the ventrum of the penis. In some cases, the glanular urethral plate was found narrow and/or fibrotic; in this situation, the narrow or fibrotic urethral plate was incised deeply in mid line to place the preputial skin flap in the resulting glanular sulcus. A simple penile dressing was then applied and the patient discharged home.

The patient was re-admitted 6 months after the first stage for the second-stage Thiersch–Duplay urethroplasty. In the second stage, under general anesthesia, the patient was placed in supine position and a U-shaped skin incision was performed around the urethral plate (bout 1.5–2.5 cm width), extending from the tip of the glans (the future meatus) to the proximal old urethral meatus as shown in Fig. 1. The glanular part of the urethral plate was then separated from the underlying glanular tissue up to the coronal sulcus, followed by tubularization of the urethral plate from the proximal meatus up to the distal end of the urethral plate (the future meatus) over a feeding tube 8F–12F using 6/0 PDS continuous suture, as shown in Fig. 2a, b. If the glanular part of the urethral plate after the first-stage procedure found contracted or scared, it was discarded and the distal part of the newly created neourethra was mobilized to the tip of the penis. In both conditions, either formation of neourethra with separation of glanular portion of the urethral plate from the underlying glanular tissue or formation of neourethra with discarded scared or contracted glanular urethral plate, the glans penis was grooved in the midline by removing a few millimeters of glanular tissue to accommodate the neourethra freely. At the same time, bilateral glanular wings were created to allow easy closure of the glans over the neourethra. The distal part of the neourethra was then embedded in the glanular groove and the meatus of the neourethra was sutured to the tip of the glans as shown in Fig. 3a. The neourethra was covered with a pedicled flap from adjacent tissues (dartos or tunica vaginalis) as a second layer, followed by closure of the glanular tissues and skin by 5/0 vicryl (Fig. 3b).



Fig. 1 A U-shaped incision on the ventrum of the penis extending from the meatus to the tip of the glans penis

Fig. 2 a, b Separation of the glanular portion from the underlying glanular tissue and tubularization of the urethral plate to create a neourethra

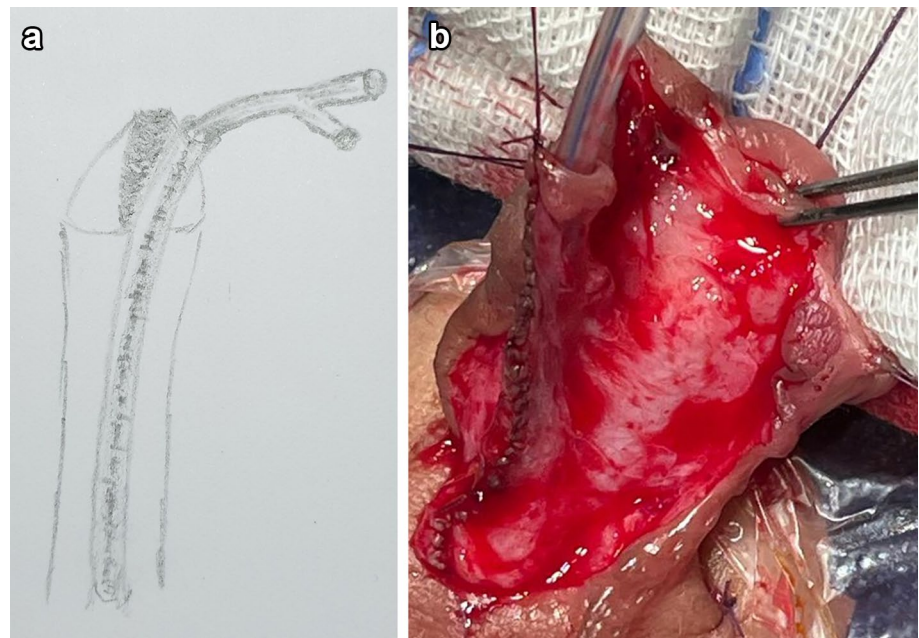
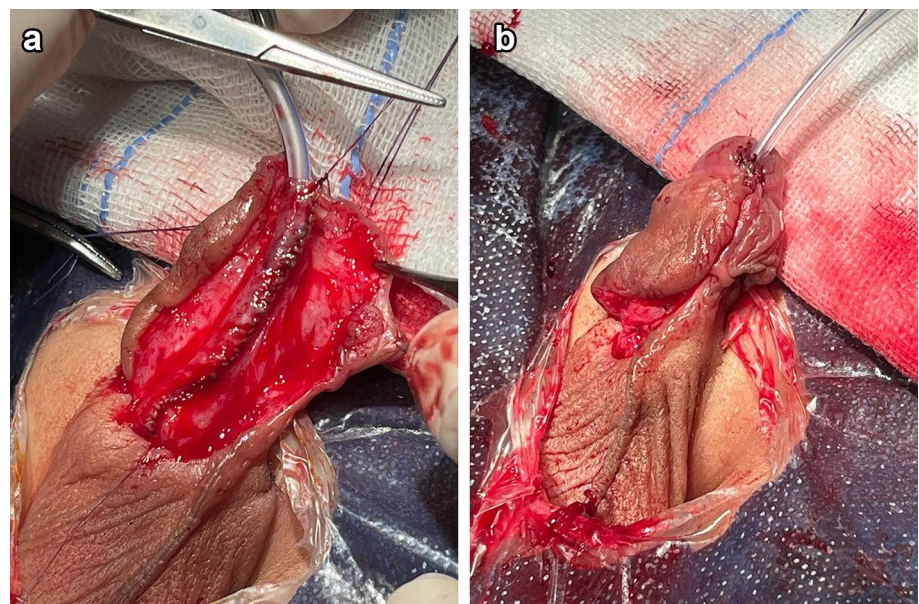


Fig. 3 a, b Mobilization of the distal neourethra and suturing the meatus to the tip of the glans penis (a) and closure of the skin with intervening second layer from adjacent dartos fascia (b)



Dressing was then applied with enough gentle pressure on the penis. The urethral stent was left in situ for 7 days, and all patients were followed up at 1, 3, 6, 9, 12, and 18 months (supplementary Figs. 4a, 4b, and 4 c).

Results

35 patients with proximal hypospadias were involved in this study. 21 patient had proximal penile hypospadias, 11 had penoscrotal hypospadias, and 3 had scrotal hypospadias. In 3 patients (2 with penoscrotal and 1 with scrotal

hypospadias), the penile curvature did not correct after excision of the chordee. Those patients necessitates a dorsal plication procedure to correct the residual curvature. The patients' age at the time of the operation ranged from 18 months to 10 years (median 3.7 years). All patients had a smooth, uncomplicated post-operative course. There were no acute complications such as hematoma, bleeding, infection, or wound dehiscence. The mean follow-up period was 15.7 months (range 12–18 months). Two patients developed urethrocutaneous fistula: the first one developed the fistula at the coronal sulcus on the 10th post-operative day, while the other one developed a mid-penile fistula 2 weeks after the

procedures. Both of them were treated by simple closure of the fistula 3 months later. After 3-, 6-, 9-, 12-, and 18-month follow-up, none of the patients had meatal stenosis, urethral stricture, or meatal retraction. At 6-month post-operative follow-up, all patients had a slit-like and wide meatus at the tip of the penis, and all of them had a good cosmetic shape glans appearance.

The demographic and clinical data are summarized in (Table 1).

Discussion

The aim of hypospadias repair surgery is to create a straight penis without chordee, a meatus at the tip of a conical-shaped glans, and a neourethra of adequate caliber [7].

In 1869, Thiersch described a technique using local tissue flaps to repair epispadias. In 1880, Duplay used a similar type of periurethral skin flaps to form a neourethra in patients with distal penile hypospadias. He had tabularized the urethral plate by doing asymmetric lateral incisions so that the urethral suture lines are unopposed [5]. Since that time, Thiersch–Duplay principle has represented the basic foundation for all the surgical methods that utilize the urethral plate to construct a urethral tube [6].

The most common reported complication of the original Thiersch–Duplay procedures are urethrocutaneous fistula, meatal stenosis meatal retraction, and glanular dehiscence [5].

To overcome those reported complications, Thiersch–Duplay concept was modified by many surgeons over years and years to get good results. One of those modifications used the buried skin strip method [8], while the other used the glans approximation procedure (GAP) for patients with coronal or glanular hypospadias [9].

Another modification is to perform an extended paraurethral incision to the tip of the glans penis to place the meatus at the tip of the penis [10]. or to use apposing epithelial flaps of the urethral plate based at the meatus to create a neourethra [11]. The use of interposition of a second layer of tissue over the neourethra is another modification to reduce the fistula rate [12].

Another modification is to combine the Thiersch–Duplay procedure with another procedure, such as to combine the Thiersch–Duplay procedure to the principles of Heineke–Mikulicz meatoplasty to widen the meatus dorsally [13], or to combine the Thiersch–Duplay principle with tabularized incised urethral plate procedure (TIP) to get a good-caliber urethral tube without tension on suture line [14–17].

In spite of those reported modifications in Thiersch–Duplay procedure to improve the results and decrease the complications, urethrocutaneous fistula, stricture formation, and meatus retractions are unfortunately still reported.

Amukele et al. [18] performed Thiersch–Duplay tubularization technique in 265 patients with proximal hypospadias. He reported 13.5% of patient developed urethrocutaneous fistula if he did not use a tunica dartos or tunica vaginalis flap as a second intervening layer, while the incidence decreased to 1.8% if a second intervening layer was used. However, Sunay [19] reported the rate of urethrocutaneous fistulae is 12.1% when he used dartos or tunica vaginalis intervening flap with Thiersch–Duplay procedure in proximal hypospadias repair.

Another investigators reported a success rate of 88%–90% with tubularized incised plate urethroplasty in conjunction with the Thiersch–Duplay technique in patients with proximal hypospadias [20, 21].

One of the commonly encountered complications of Thiersch–Duplay tube is meatal stenosis. Even the use of urethral plate incisions modifications may heal with excessive fibrosis and meatal stenosis will result. Palmer et al. [20] did not report any cases of meatal stenosis in his series, while Snodgrass et al. [17] Amukele et al. [18], and Chen et al. [21] reported 1, 3, and 4 meatal stenosis, respectively.

Freeing the urethral plate from the glanular bed and creating a glanular cylindrical groove in our modification is

Table 1 The table shows the demographic and clinical data of the patients

Demographic and clinical data		
Patients age		
Range	18 months–10 years	
Mean	3.7 years	
SD	±24.6	
Type of hypospadias	No	Percent %
Proximal penile hypospadias	21	60%
Penoscrotal hypospadias	11	31.4
Scrotal hypospadias	3	8.6%
Total	35	100%
Penile curvature corrections	No	Percent %
Chordee excision only	32	91.4%
Chordee excision with dorsal plication	38	8.6%
Total	35	100%
Follow-up		
Range	12–18 months	
Mean	15.7 months	
SD	±1.9	
Post-operative complications	No	Percent %
Urethrocutaneous fistula	3/35	8.5%
Other complications: (meatal stenosis and/or meatal retraction)	0	0%

associated with very low complications compared to the other Thiersch–Duplay modifications in two-stage proximal hypospadias repair. Freeing the urethral plate from its glanular bed allows the creation of a good-caliber neourethra tube without tension on suture line, as the urethral plate tissue can be expanded after being freed from its glanular bed. We did not notice any vascular changes in the urethral plate tissues after their release from the glanular bed. On the same time, the creation of glanular cylindrical groove by excising a few millimeters of glanular tissue all around allows easy and free embedding of the created neourethra inside the glans, easy covering of the suture line of the neourethra by a vascularized flap from dartos or other nearby tissue, and easy closure of the glans without tension on the glanular suture line.

Using our modification to Thiersch–Duplay procedure in proximal urethroplasty on 35 patients, our results compared to other procedures are encouraging us to use this modification not only in proximal urethroplasty, but we are now using this modification in distal hypospadias repair compared to TIP procedure as a new research project.

Conclusion

Creation of mid-urethral plate incision, and covering the sutural line by secondary layer is not enough to decrease the post-operative complications of Thiersch–Duplay urethroplasty. We believe that separation of the urethral plate from the underlying glans and creation of glanular groove to accommodate the neourethra allow adequate glanular closure and minimization of post-operative meatal stenosis, glanular dehiscence, and meatal retraction.

Limitations of the study

Our study has two limitations which must be acknowledged. First, the number of the specimen is relatively small. Second, our follow-up is relatively short. Despite these limitations, we believe that our findings are meaningful.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s11255-023-03833-5>.

Author contributions HMED: Data analysis, manuscript writing. MEAD: Protocol development, data analysis. OSA: Data analysis, manuscript editing. MSK: Data collection. SRS: Data collection. MRT: Manuscript editing.

Data availability Not applicable.

Declarations

Conflict of interest The authors declare that they have no conflict of interest.

Research involving human participant and/or animals All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee.

Informed consent Informed consent was signed by the parents of each patient involved in this study.

References

1. Sweet RA, Schrott HG, Kurland R et al (1974) Study of incidence of hypospadias in Rochester, Minnesota 1940–1970, and a case control comparison of etiological factors. *Mayo Clin Proc* 49:52–56
2. Duckett JW (1980) Transverse preputial island flap technique for repair of severe hypospadias. *Urol Clin Noala Am* 7:423–431
3. Bracka A (1995) Hypospadias repair: The two-stage alternative. *Br J Urol Int* 76(suppl 3):31–41
4. Hanna M, Weiser AC (2004) Thiersch–Duplay principle. In: Hadidi AT et al (eds) *Hypospadias surgery*. Springer, Heidelberg
5. Decter RM (1991) M Inverted V glansplasty: a procedure for distal hypospadias. *J Urol* 146:641
6. Decter RM, Franzoni DF (1998) Distal hypospadias repair by the modified Thiersch–Duplay technique with or without hinging the urethral plate: a near ideal way to correct distal hypospadias. *J Urol* 162:1156
7. Baskin LS, Ebberts MB (2003) Hypospadias: anatomy, etiology, and technique. *Urology* 61:1019–1022
8. Browne D (1949) An operation for hypospadias. *Proc R Soc Med* 41:466
9. Zaontz MR (1989) The GAP (glans approximation procedure) for glanular/coronal hypospadias. *J Urol* 141:359
10. Van Horn AC, Kass FJ (1995) Glanuloplasty and in situ tubularization of the urethral plate: simple reliable technique for the majority of boys with hypospadias. *J Urol* 154:1505
11. Barcat J (1969) L'hypospadias. III. Les urethroplasties, les resultats-les complications. *Ann Chir Infant* 10:310
12. Koff SA, Brinkman J, Ulrieh J et al (1994) Extensive mobilization of the urethral plate and urethra for repair of hypospadias: the modified Bareat technique. *J Urol* 151:466
13. Stock JA, Hanna MK (1997) Distal urethroplasty and glanuloplasty procedures: results of 512 repairs. *Urology* 49:449
14. Reddy LN (1975) One stage repair of hypospadias. *Urology* 5:475
15. Snodgrass W (1994) Tubularized, incised plate urethroplasty for distal hypospadias. *J Urol* 151:464
16. Snodgrass W, KoyleM MG et al (1996) Tubularized ineised plate hypospadias repair: results of a multieenter experience. *J Urol* 1996156:839
17. Snodgrass W, Keys M, Manzoni G et al (1998) Tubularized ineised plate hypospadias repair for proximal hypospadias. *J Urol* 159:2129
18. Amukele SA, Weiser AC, Stock JA et al (2004) Results of 265 consecutive proximal hypospadias repairs using the Thiersch–Duplay principle. *J Urol* 172:2382–2383
19. Sunay M, Emir L, Karabulut A, Erol D (2009) Our 21-year experience with the Thiersch–Duplay technique following surgical correction of penoscrotal transposition. *Urol Int* 82:28–31. <https://doi.org/10.1159/000176021>

20. Palmer LS, Palmer JF, Franco I et al (2002) The 'long snodgrass': applying the tubularized incised plate urethroplasty to penoscrotal hypospadias in 1-stage or 2-stage repairs. *J Urol* 168:1748–1750
21. Chen SC, Yang SSD, Hsieh CH et al (2000) Tubularized incised plate urethroplasty for proximal hypospadias. *BJU Int* 86:1050–1053

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