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Hybrid one-stage Snodgrass–Duckett urethroplasty for severe hypospadias. A five-year institutional experience

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Abstract

Proximal and complex hypospadias repairs remain among the most technically demanding procedures in pediatric urology, particularly in patients with inadequate local tissue or previous failed reconstructions. This study reports a five-year institutional experience with a single-stage hybrid technique combining the Snodgrass Tubularized Incised Plate (TIP) repair and the Duckett transverse preputial island flap urethroplasty. Between 2019 and 2024, forty-two patients with severe hypospadias underwent hybrid Snodgrass–Duckett urethroplasty at our institution. Patients were categorized as: Group A (n = 12) with 46,XY Disorders of Sexual Development (DSD); Group B (n = 16) with primary proximal perineoscrotal hypospadias; and Group C (n = 14) with multiple failed prior repairs. The proximal urethra was reconstructed using a Tubularized Native Plate (TNP) and the distal segment with a tubularized preputial island flap (Duckett), joined via an oblique anastomosis. Penile curvature correction and ventral coverage were achieved using lateral flaps. Functional and cosmetic outcomes, as well as complications, were recorded prospectively. A glans-tip meatus was achieved in all patients. Cosmetic appearance was deemed satisfactory in all cases. Uroflowmetry was normal in 95.2% (40/42; 95% CI 86.6–100). Complications occurred in seven patients (16.7%; 95% CI 5.6–27.7), including urethrocutaneous fistula (n = 4), diverticulum (n = 1), and early breakdown (n = 2), all successfully corrected. Median follow-up was 26 months (IQR 18–36). No urethral strictures or meatal stenosis developed during follow-up. The hybrid Snodgrass–Duckett urethroplasty represents a feasible single-stage alternative for selected severe hypospadias cases, including reoperative and DSD patients, when local tissue is insufficient. The approach combines the vascular reliability of the preputial flap with the stability of the native urethral plate. While results are encouraging, the retrospective design, absence of a control group, and heterogeneity of the cohort limit generalizability. Prospective multicenter studies with standardized functional and cosmetic scoring are warranted.

Key words: proximal hypospadias, urethroplasty, Snodgrass technique, Duckett flap, disorders of sexual development.

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Introduction

Hypospadias is a common congenital anomaly, affecting 5–10 per 1,000 live male births, with proximal variants accounting for up to 20% of cases.[1,2] Severe forms, including perineoscrotal and scrotal hypospadias, are frequently associated with significant chordee, hypoplastic urethral plate, deficient ventral skin, and occasionally Disorders of Sexual Development (DSD). Achieving optimal functional and cosmetic outcomes in these cases remains challenging.[3-5]

Despite continuous advances in surgical technique, no single method has proven universally superior for proximal or reoperative hypospadias. The Tubularized Incised Plate (TIP) urethroplasty and the Transverse Preputial Island Flap Urethroplasty (TPIFU) remain the mainstay procedures, yet each carries limitations when applied to complex cases. Recent meta-analyses and multicenter series continue to report complication rates between 20% and 40% in proximal cases despite technical refinements,[8-11] underscoring the persistent challenge of achieving durable, single-stage success.

Hybrid or tailored reconstructive strategies have therefore gained renewed interest, aiming to balance tissue vascularity, minimize suture-line tension, and optimize neourethral length. In our institution, we adopted a pragmatic single-stage approach that combines proximal urethral plate tubularization (Snodgrass TIP) with a distal preputial island flap (Duckett TPIFU).

The present study reports a five-year institutional experience with this hybrid Snodgrass–Duckett urethroplasty, evaluating its feasibility, functional and cosmetic outcomes, and complication profile in a heterogeneous cohort of severe hypospadias, including reoperative and DSD cases.

Materials and Methods

This retrospective review included all consecutive patients with severe hypospadias who underwent hybrid Snodgrass–Duckett urethroplasty between January 2019 and December 2024 at our institution. Inclusion criteria were proximal (scrotal or perineoscrotal) meatus, significant chordee (>50°), inadequate urethral plate, and insufficient local preputial mucosa for single-technique repair (Figure 1). Exclusion criteria included distal hypospadias, minimal chordee, or patients undergoing a staged repair already in progress.

All patients underwent detailed clinical examination, uroflowmetry (if age-appropriate), and photographic documentation. DSD patients received karyotyping, hormonal profiling, and multidisciplinary evaluation. In DSD cases, intramuscular testosterone (100 mg/m²) was administered four weeks preoperatively to optimize penile size.

Under general anesthesia with caudal block, the native urethral plate was incised in the midline and tubularized over an 8 Fr catheter (Snodgrass TIP; Figure 2). A vascularized preputial island flap was harvested, tubularized (Duckett), and anastomosed obliquely to the proximal segment. Tunica vaginalis or dartos flaps were applied for coverage, and a suprapubic cystostomy was used for diversion.

Follow-up visits were at 1, 3, 6, and 12 months, then annually (Figure 3). Cosmetic results were assessed clinically; functional results included urinary stream and uroflowmetry. Although validated scoring systems (HOSE, PPPS) were not routinely used, assessments were standardized by the same surgeon and nurse team. Data were analyzed descriptively. Ethics approval and parental consent were obtained.

Results

A total of 42 patients met inclusion criteria. Median age was 5.3 years (range 1.3–14). All had severe chordee and inadequate local tissue for single-technique repair. Group distribution: DSD (n=12), primary proximal hypospadias (n=16), reoperative (n=14).

A glanular meatus was achieved in all patients. Uroflowmetry was normal in 40/42 (95.2%, 95% CI 86.6–100). Complications occurred in 7/42 (16.7%, 95% CI 5.6–27.7): urethrocutaneous fistula (4), urethral diverticulum (1), early breakdown (2). All were corrected with minor surgery. No strictures or recurrent chordee were seen. Median follow-up was 26 months (IQR 18–36; see Table 1 for a summary of the outcomes).

Discussion

Hypospadias repair remains one of the most technically challenging areas in pediatric urology, particularly in its proximal and complex forms.[4] Advances in flap design and perioperative care have consolidated the use of TIP, TPIFU, and two-stage Bracka repairs.[5-7,13] Recent multicenter series confirm ongoing high complication rates,[8-11] emphasizing the need for pragmatic, patient-tailored strategies.

Our hybrid approach combines proximal urethral plate tubularization (TIP) with distal preputial flap (Duckett) via an oblique anastomosis, distributing suture tension and preserving vascularity. This proved valuable in DSD and reoperative cases, where local tissues are scarce. Preoperative testosterone therapy improved penile size, consistent with reports by Saka and Netto.[12,13]

Compared with the existing literature, our complication rate of

Figure 1. Clinical presentation of hypospadias with low positioning of the external urethral meatus accompanied by ventral penile curvature.

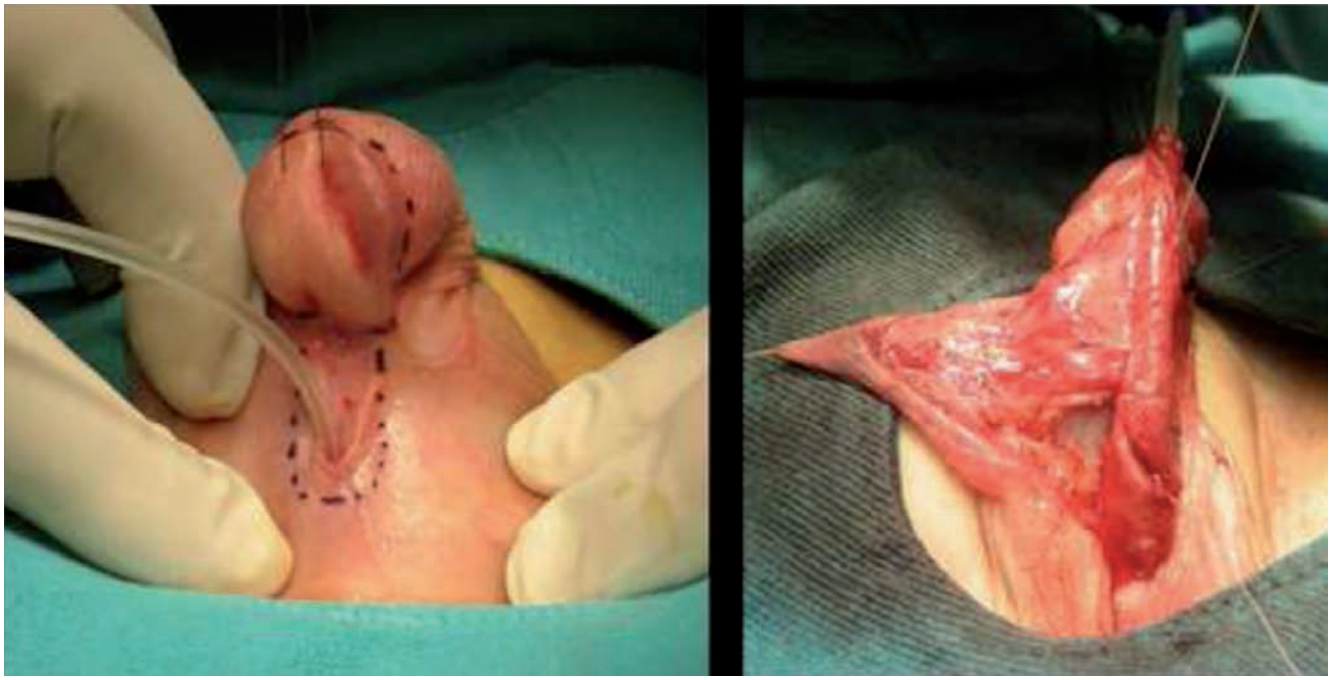

Figure 2. Intraoperative view of the combined technique: the proximal urethra was reconstructed via tubularization of the urethral plate following the Snodgrass (TIP) technique, while the distal urethra was fashioned using an island flap from the inner preputial layer according to the Duckett method. The two segments were anastomosed at an oblique junction.

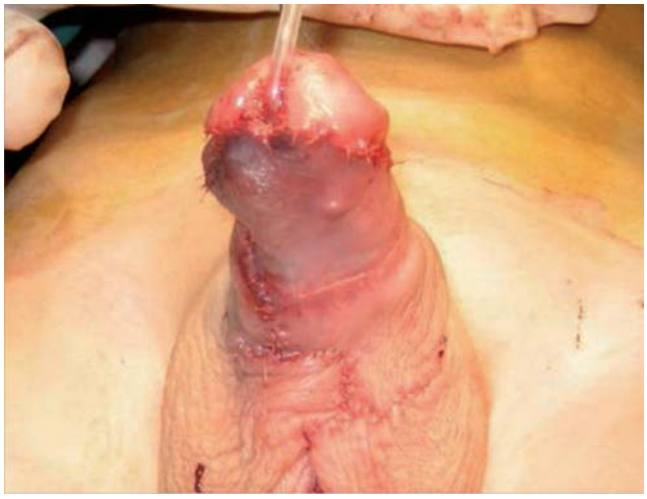

Figure 3. Postoperative result showing the final reconstruction of the penis and scrotum, with the neourethra in its functional and anatomical position.

16.7% appears favorable relative to published single-stage series of comparable severity. Wang *et al.*[9] reported an overall complication rate of 28.9% for proximal repairs using a modified Duckett technique, while Li *et al.*[17] and Gozar *et al.*[21] emphasized the continued high risk of fistula and stricture formation with traditional TPIFU.

In contrast, Xie *et al.*[22] demonstrated that a staged TIP urethroplasty could achieve excellent results in proximal hypospadias with severe chordee, reporting low fistula rates and improved penile straightening. Their findings reinforce the principle that optimal outcomes depend on minimizing tension and preserving vascularity. Our hybrid one-stage repair was designed to incorpo-

Table 1. Summary of key outcomes.

Outcome	n / Total (%)	95% CI	Notes
Functional success (normal flow, no obstruction)	40 / 42 (95.2%)	86.6 – 100	Bell-shaped curves
Cosmetic success (satisfactory on clinical exam)	42 / 42 (100%)	—	Glanular meatus in all
Overall complication rate	7 / 42 (16.7%)	5.6 – 27.7	All corrected
Urethrocutaneous fistula	4 / 42 (9.5%)	2.7 – 22.6	—
Urethral diverticulum	1 / 42 (2.4%)	—	—
Early breakdown	2 / 42 (4.8%)	—	—

rate these same biomechanical principles within a single procedure — by segmenting the neourethra into proximal TIP and distal flap components, joined obliquely to reduce suture-line stress while maintaining adequate blood supply.

Recent innovations aiming to enhance one-stage results, such as Buck's fascia integral covering,[14] multilayer vascular protection, and postoperative suprapubic diversion,[15,16] also align with this concept and may explain our low stricture incidence.

The development of urethrocutaneous fistula remains the most frequent complication after hypospadias repair. A recent meta-analysis by Chua *et al.*[23] and the multicenter Indonesian study by Duarsa *et al.*[24] both identified proximal location, chordee, single-layer coverage, suture-line tension, and absence of multilayer vascular protection as significant risk factors. These parameters correspond closely to the anatomical and technical challenges in our cohort. In our series, meticulous tissue handling, multilayer tunica vaginalis or dartos coverage, and routine suprapubic diversion likely mitigated these factors, resulting in a relatively low fistula rate (9.5%) compared to reported averages.

Limitations include the retrospective design, small cohort, and absence of validated scoring systems, although the uniform follow-up and single-surgeon performance strengthen internal consistency. Future multicenter prospective studies with standardized outcome measures are warranted to validate this approach. As highlighted by Gozar *et al.*,[21] improved outcome reporting and inter-institutional collaboration remain essential to defining optimal strategies for complex hypospadias.

In summary, the hybrid Snodgrass–Duckett urethroplasty offers a practical, anatomically sound single-stage option for selected severe cases, balancing reliability with reconstructive efficiency.

Conclusions

The hybrid Snodgrass–Duckett urethroplasty represents a feasible and anatomically sound single-stage option for selected cases of severe hypospadias, including reoperative and DSD patients, in which local tissue is insufficient for standard repair. By combining the stability of the tubularized urethral plate with the vascular reliability of the preputial island flap, this approach allows simultaneous correction of curvature and reconstruction of an adequately long, well-vascularized neourethra.

In our five-year experience, functional and cosmetic outcomes were satisfactory, with a low rate of complications and no urethral strictures observed during follow-up. While these findings compare favorably with contemporary single-stage series, the retrospective nature of the study and the limited sample size require cautious interpretation.

Further prospective, multicenter studies incorporating validated cosmetic and functional outcome measures are needed to confirm these results and clarify the role of this hybrid technique within the evolving reconstructive spectrum for complex hypospadias.

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Conflict of interest: the authors declare no conflicts of interest related to this study.

Ethics approval: Ethics Committee approval was waived due to the retrospective design of the study and the use of anonymized data. The study was conducted in accordance with the Declaration of Helsinki.

Informed consent: written informed consent was obtained from the parents or legal guardians of all participants.

Patient consent for publication: written informed consent was obtained from the legal guardians for the publication of anonymized patient data and images.

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