Snodgrass repair for distal hypospadias: a review of 75 cases
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Background/aim In 1994, Warren Snodgrass described his technique of tubularized incised plate urethroplasty, which is a relatively straightforward one-stage procedure. It has become the standard technique used by many urologists for distal hypospadias correction. We review our cases to find out whether there was any difference in the rate of urethrocutaneous fistula after the use of single- versus double-layer tubularization, the use of thick versus thin dorsal prepuce subcutaneous flap (DPF), the use of DPF versus the ventral dartos flap for repair cover, and also to find out whether the extension of the urethral plate incision till the neomeatus was associated with an increased rate of meatal stenosis.

Patients and methods We reviewed the operative notes and the out-patient files of all patients who underwent Snodgrass repair for distal hypospadias, over a period of 8 years. Follow-up extended from 2 to 24 months postoperatively. The variables addressed were as follows: the age during repair, the type of hypospadias, the tubularization technique, whether it was a single layer or with an additional reinforcing, second layer, the cover flap (dorsal prepuce subcutaneous vs. ventral local dartos fascia), the thickness of the dorsal flap when used (thin vs. thick), and the distal limit of the plate incision, whether including the site of the neomeatus or not. The complications addressed were the occurrence of urethrocutaneous fistula and meatal stenosis.

Results The study included 75 cases. Twenty-one (28%) boys operated were below 6 months, 17 (23%) between 6 and 12 months, and 37 (49%) above 1 year of age. A single suture-line tubularization was used in 17 (23%) and a reinforcing second layer was added in 58 (77%) patients [urethrocutaneous fistulae occurred in two (11.8%) and five (8.8%) patients, respectively]. The second layer flap was the dorsal subcutaneous prepulse in 63 (84%), thin in 16 (25%), and thick in 47 (75%) patients [urethrocutaneous fistulae occurred in two (12.5%) and four (8.5%) patients, respectively]. The ventral local dartos flap was used in 12 (16%) cases (all were already circumcised) [the fistula occurred in one (8%) patient]. The neomeatus site was included in the urethral plate incision in 45 patients, and not included in 30 [meatal stenosis occurred in eight (18%) and two (7%) patients, respectively].

Conclusions In Snodgrass repair of distal hypospadias, tubularization in two layers, together with proper harvesting of the thick DPF, decrease the fistula rate. Extending the plate incision to the neomeatus site is a predisposing factor for meatal stenosis. Ann Pediatr Surg 8:12–14 © 2012 Annals of Pediatric Surgery.

Keywords: hypospadias, Snodgrass, tubularized incised plate, urethroplasty

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Results
From January 2003 to December 2010, 181 cases of hypospadias were repaired by the author. Seventy-five cases had Snodgrass repair for distal hypospadias. The age ranged from 2 months to 18 years (mean 30.5 months). Six (8%) had glanular, 13 (17%) subcoronal, 45 (60%) distal penile, and 11 (15%) mid-penile meatus. Twenty-one (28%) boys operated were below 6 months, 17 (23%) between 6 and 12 months, and 37 (49%) above 1-year of age. Single suture-line tubularization was used in 17 (23%) and a reinforcing layer was added in 58 (77%) patients \[\chi^2 = 0.143, P\text{-value non significant}\]. The second layer flap was the dorsal subcutaneous prepuce in 63 (84%), thin in 16 (25%), and thick in 47 (75%) patients, \[\chi^2 = 0.2, P\text{-value non significant}\]. The ventral local dartos was used in 12 (16%) cases (all were already circumcised) \[the fistula occurred in one (8%) patient\]. The neomeatus site was included into the urethral plate incision in 45 patients, and not included in 30 \[meatal stenosis occurred in eight (18%) and two (7%) patients, respectively; \chi^2 = 1.9, P\text{-value non significant}\]. Overall, urethrococutaneous fistulae occurred in seven (9.5%) and meatal stenosis in 10 (13%) cases. Tables 1–2 summarize the results.

Discussion
The incidence of hypospadias is one out of 300 male births. The majority of the cases are distal \[4,6\]. Since it was introduced in 1994, Snodgrass urethroplasty \[1\] has been the adopted procedure for distal hypospadias correction by many urologists \[2,9,10\]. Its versatility, together with the normally appearing meatus, has made it the preferred technique. Although the technique has also been used for the repair of proximal hypospadias, our study focused on the distal cases because they are more common and reliably corrected in one stage. The most feared complications after tubularized incised plate urethroplasty procedure are the urethrococutaneous fistula and meatal stenosis \[4,5,10\]. Various techniques were used to decrease the incidence of urethrococutaneous fistula. Gentle tissue handling with precise identification of minute tissue relations and preservation of the periurethral vascular supply are essential \[5,10\]. We use Loup (X 2.5) as a routine. Different technical points were raised to decrease the incidence of fistula formation. The importance of the second layer cover flap was agreed as an important step \[1,4,5,7,8,11\]. DPF was the one used by Snodgrass himself to cover his repair \[1,2,4\]. Although Ross and Kay \[12\] raised the concern that...
mobilization of this flap may compromise the blood supply to the skin closure and predispose to torsion, this has been our main flap. We rotated the flap from one side and covered the repair (Fig. 2b) without any penile torsion or vascular compromise of the dorsal penile skin in any case. The same observation was reported by Dechter and Franzoni [7], who found that the vascularized pedicle of subcutaneous tissue, covering the neourethra, resulted in a statistically significant decrease in the fistula rate over the use of the adjacent local tissue. Again, the subcutaneous flap, in their experience, had not adversely affected cosmesis or led to problems with torsion.

However, with more practice, we found that the thickness of the flap was an important factor in fistula prevention. Although statistically not significant, thin flaps with even good blood vessels running through it, were not enough to decrease our fistula rate. The flap, when thick, non-transparent, allowing good vascular tissue bulk to be laid over the repair (Fig. 2a and b), decreased the rate of fistula (12.5 vs. 8.5%).

Another important factor was the use of an additional reinforcing, second layer for the tubularization versus a single one. We believe that the urethral plate, when dissected, should be thick enough to allow for tubularization in two layers, namely the first subepithelial together with a second reinforcing one.

Our fistula rate has changed from 11.8% in the early cases to 8.8%, which is comparable to other series from other institutions [2,10]. Our fistula rate, although initially disappointing, represents a learning curve associated with the realization of the points addressed before: the tubularization in two layers and proper harvesting of the thick dorsal flap.

Meatal stenosis generally occurs in up to 7% of patients after hypospadias repair [2,5,10]. Extending the urethral plate incision till the site of the neomeatus was considered by some as a predisposing factor [3]. This was seen in our cases. When the neomeatus site was not included in the plate incision, the meatal stenosis rate almost decreased from 18 to 7%.

## Conclusion

Although statistically insignificant, our experience showed that in Snodgrass repair of distal hypospadias, two-layer tubularization, together with proper harvesting of the thick dorsal subcutaneous prepuce flap, decrease the fistula rate. Extending the plate incision to the neomeatus site is a predisposing factor for meatal stenosis. A larger prospective controlled study is required.

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The work adhered to the ethical policy of the hospital.

## Conflicts of interest

There are no conflicts of interest.

## References