ORIGINAL RESEARCH

# Use of Barrier Layer for Primary Tubularized Incised Plate Urethroplasty for Hypospadias: Comparing Outcomes of Dartos and Tunica Vaginalis Flap

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Hypospadias is as relatively common congenital disrder, but its repair remain to be among the most challenging of operations. Complications, most commonly urethrocutaneous fistula, occur even in the hands of experienced surgeons. The use of vascularized pedicled flap (i.e. dartos and tunica vaginalis flap) has been promoted of improving complication rates.

***Objective***: This study aimed to determine the complication rates of hypospadias repair with dartos flap versus tunica vaginalis flap using Snodgrass tecnhique.

***Materials and Methods***: From January 2006 to July 2015, 230 patients underwent repair of hypospadias via the Tubularized Incised Plate (Snodgrass) technique by a single surgeon. One hundred ninety had adequate records evaluable for study. Baseline characteristics gathered at surgery were 1. penile length, 2. urethral plate characteristics in terms of quality and width, 3. degree of chordee, 4. meatal location, 5. quality and blood supply of penile skin. Post-operative complication rates were determined, and specific post operative problems (urethrocutaneous urethrocutaneous fistula, meatal/urethral stenosis, skin flap necrosis, meatal regression, and recurrent chordee) were accounted for.

***Results***: There were 135 (71.1%) patients in the dartos flap (DF) group and 55 (28.9%) in the TVF layer group. The mean age for the whole study population was 4.70 + 4.25 years. There was no significant difference in the baseline pre-operative characteristics namely, urethral plate characteristics, degree of chordee, meatal location, and penile skin blood supply. The overall complication rate was 32.1% (61/190). There was a significant difference in overall complication rate, with 14.5% (8/55) and 39.6% (53/135) complication rate in the DF and TVF groups, respectively (p= .003). The urethrocutaneous fistula rate was 21.6% (41/190), with a significant difference between DF and TVF groups (27.6% vs 7.3%, p= .007). There was no significant difference between the 2 groups in the other listed complications.

***Conclusions***: Snodgrass technique in combination with tunica vaginalis flap as a second layer appears to be a reliable technique to improve complication rates, particularly urethrocutaneous fistula. Further experience in its utilization can potentially further improve future outcomes.

***Key words***: hypospadias, Dartos flap, tunica vaginalis flap

## Introduction

Hypospadias is a congenital malformation caused by incomplete fusion of the urethral folds, in which the meatal orifice opens into the inferior surface of the penis.[1] With a prevalence of 1 per 300 live births, it is a relatively common condition encountered by urologists. [2]

Hypospadias repair remain to be one of the most challenging operations, with a steep learning curve. A prospective analysis on the results of hypospadias surgery performed by a single surgeon found that it takes at least 5 years of constant experience in doing the procedure to achieve favourable surgical outcomes. [3] Complications arise even in the most experienced hands, and there remains no gold standard technique in managing hypospadias. Among the post-operative complications of hypospadias surgery, Urethrocutaneous fistula is the most common and is the most often cited measure of success in hypospadias surgery.[4,5] Other listed complications include meatal stenosis and regression, chordee recurrence, and skin flap necrosis. [6]

Like other reconstructive surgeries, vascularity is one of the major factors in hypospadias that is required for a successful outcome. In 1973, Smith utilized the 'pants over vest' technique using de-epithelialized skin over the neourethra to increase the vascularity.[7] Snow in 1986 and Kirkali in 1990 were among the first proponents in using the tunica vaginalis pedicled wrap. The flap is a good vascular tissue for augmenting vascularity around the neourethra.[8,9] In 1968, a scrotal flap that was used in urethroplasty for urethral strictures was proposed by Blandy *et al* to minimize fistula formation.[10] A dartos flap without the skin was also used for hypospadias urethroplasty and in urethral stricture by Motiwala.[11] An important milestone in hypospadias surgery came when Snodgrass and Lorenzo proposed a technique by which a tubularized incised plate (TIP) and a dartos wrap was used in urethroplasty among hypospadias.[12] It has now become the most common technique employed for hypospadias repair.[13]

Various factors have been shown to significantly impact the success of hypospadias surgery: penile length [6], urethral plate caharacteristics [6,14], presence and severity of chordee[6], meatal location [15], quality and blood supply of penile skin [16]. However, the interposition of well-vascularized tissue between the skin and neourethra to avoid overlapping of suture lines is a basic tenet of hypospadias surgery. It is recommended to promote positive outcome in both primary and repeat hypospadias repair and to decrease the rate of complications, mainly urethrocutaneous fistula formation.[17-19]

A good number of reports have shown better outcome of hypospadias repair with use of various vascularized flaps, like scrotal or peputial dartos fascia and tunica vaginalis flap.[20] These flaps are placed on the water-tight neourethra as the second or barrier layer.[21] Most older series utilized the dartos flap, but since the introduction of the TVF, there has been increasing use of the latter. While initially utilized for re-do procedures, several reports, albeit rather small series on primary repair, have been showing superior outcomes of TVF over dartos flap in terms of complications, particularly urethrocutaneous fistula. [8,9,22-27]

Thus, there seem to be an improving trend in complications for TVF over dartos flap. However, the results are still rather conflicting, and this study aims to further define the role of TVF in hypospadias repair to potentially improve complication rates.

This study aimed to determine the complication rates in hypospadias repair using Snodgrass technique with the use of dartos flap (DF) versus tunica vaginalis flap (TVF). Its other objective was to assess the advantage of TVF compared to the use of DF in hypospadias repair in reducing complications, namely, urethrocutaneous fistula, meatal stenosis, skin flap necrosis, meatal regression, residual chordee.

## Materials and Methods

*Patient Selection*

From January 2006 to July 2015, 230 patients underwent repair of hypospadias via the Tubularized incised plate technique following Snodgrass description by a single surgeon.

From the existing database, baseline characteristics gathered at surgery were: 1. penile length, 2. urethral plate caharacteristics in terms of quality (shallow, intermediate, deep) and width (<8mm, > 8mm); coding done are good- deep and >8mm, intermediate- combination of quality/ width, poor- shallow and <8mm [6,14], 3. degree of chordee (<30, 30-60, >60) [6], 4. meatal location[15], 5. quality and blood supply of penile skin based on the characteristics of the predominant vessel

(poor- 1 blood vessel predominant, intermediate- 2-blood vessels predominant, good- H/net-like form).[16]

Post-operative complications reviewed were urethrocutaneous fistula, meatal/urethral stenosis, skin flap necrosis, meatal regression, and recurrent chordee.

*Description of Technique in Repair of Hypospadias*

The operation is based from Tubularized Incised Plate repair described by Snodgrass.[12,29] 4-0 silk sutures are placed in the glans for traction and later to secure the urethral stent. Longitudinal incisions are made along the visible junctions of glans wings to the urethral plate, and further mobilized using tenotomy scissors. A tourniquet at the penile base for hemostasis was positioned. A midline incision of the urethral plate is done, and extends down to near the corpora cavernosa. A Fr 6-8 silastic stent is placed to the bladder, and the urethral plate tubularized from the neomatus using fine sutures (usually 7-0 polyglactin sutures). Tubularization is completed with a running, watertight two-layer subepithelial closure creating a neourethral lumen. A pedicle flap is then placed, either a dartos flap as originally used by Snodgrass, or a tunica vaginalis flap as a modification (Figure 1,2 ).

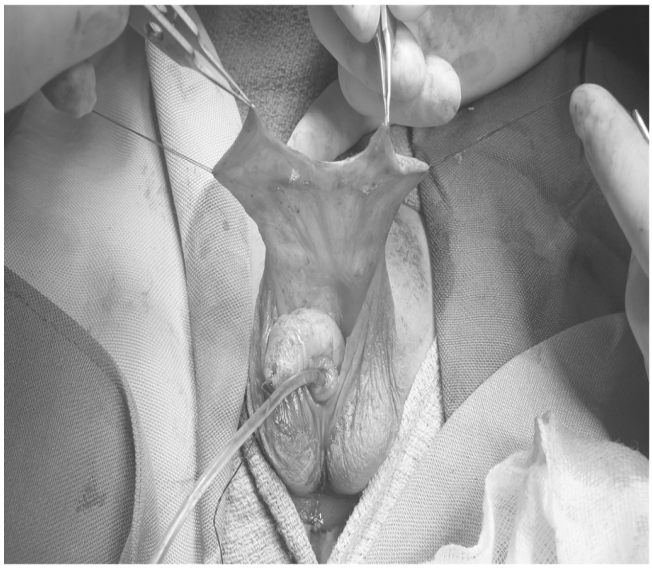

**Figure 1**. Preputial dartos being prepared for use as second layer over the neourethra.

**Figure 2**. Tunica Vaginalis pedicle flap being prepared prior to placement over the neourethra.

Glansplasty is finally done, with additional buttress sutures subepithelilally placed to the neomatus. Taking special attention to blood supply and arborization of the vessels in fashioning the skin flap, closure (usually 6-0 polyglactin) using Z-plasty is done. All surgery were performed with magnification loops.

A Tegaderm™ dressing is placed, which falls off spontaneously within a few days. Oral antibiotics are maintained for a week, and analgesics are likewise prescribed. Stents are pulled out on follow up within a week from surgery.

*Data Management and Statistical Analysis*

Mean and standard deviation (SD) will be used to summarize numerical data. Percentages and frequency were used for nominal and ordinal data. Independent t-tests were utilized in comparison of means. Fischer's exact test used in comparison of percentages. Pearson chi-square homogeniety were used to compare the groups in relation to the operative outcomes and complications. All the statistical tests were performed using SPSS ver. 20. P-values less than 0.05 are to be considered significant.

**Results**

There were 190 patients included in the study 135 (71.1%) in the DF group and 55 (28.9%) in the TVF layer group. The mean age for the whole

study population was 4.70 + 4.25, with mean age for DF group at 4.97 + 4.14 and TVF group at 5.26 + 4.35 . The mean follow up for the group of patients was 34.9 months (range 2-113 months). The mean penile length for the DF and TVF group were 3.93 + 1.89 and 3.89 + 1.53 cm, respectively. The two groups had homogenous baseline demographics. Table 1 summarizes the patient profiles.

**Table 1**. Demographics.

| | Flap | Mean | t | p-value |
|---|---|---|---|---|
| Age (years) | Dartos<br>Tunica<br>Vagnalis | 4.97<br>± 4.14<br>5.26<br>± 4.35 | -.405 | .686 |
| Penile length (cm) | Dartos<br>Tunica<br>Vaginalis | 3.93 ± 1.89<br><br>3.89 + 1.53 | .149 | .882 |

The baseline operative parameters evaluated were degree of chordee, meatal location, quality of urethral plate, and penile skin blood supply. Nineteen (10%) had no chordee, 102 (53.7%) had <30 degree chordee, 43 (22.8%) had 30-60 degree chordee, and 26 (13.7%) had chordee >60 degrees. Between the DF and TVF flap groups, there was no significant difference in the degree of chordee prior to surgery (p= .855).

In terms of meatal location, 3 (1.6%) were glanular, 16 (8.4%) were subglanular, 26 (13.7%) were distal penile, 56 (29.5%) were mid penile, 15 (7.9%) were proximal penile, 17 (8.9%) were penoscrotal, 17 (8.9%) were scrotal, and 12 (6.3%) were perineal. There is no significant difference between DF and TVF flap groups in terms of meatal location (p=.059)

With regards to quality of the urethral plate, 37 (19.7%) were perceived as poor, 124 (66%) were moderately developed, and 27 (14.4%) were well developed. There was no significant difference between the two groups being compared (p=.463)

Penile skin vascularity was also assessed intra-operatively, with 31 (16.6%) being good, 21 (11.2%) being intermediate, and 135 (72.2%) being thin. There was no significant difference between the 2 groups under study (p=.093). Table 2 summarizes the baseline operative parameters.

**Table 2**. Baseline operative parameters.

| Operative Parameters | | Layer Used<br>Dartos (n=135) | <br>Tunica Vaginalis (n=55) | Total | Pearson Chi-Square<br>Value | <br>Asymp. Sig. (2-sided) |
|---|---|---|---|---|---|---|
| Degree of chordee | None | 15<br>11.2% | 4<br>7.3% | 19<br>10.0% | 2.614 | .855 |
| | <30 degrees | 73<br>53.7% | 29<br>52.7% | 102<br>53.7% | | |
| | 30-60 degrees | 31<br>23.1% | 12<br>21.8% | 43<br>22.6% | | |
| | >90 degrees | 16<br>11.9% | 10<br>18.2% | 26<br>13.7% | | |
| Meatal location | Glanular | 1<br>.0% | 2<br>3.6% | 3<br>1.6% | 6.259 | .059 |
| | Subglanular | 14<br>10.4% | 2<br>3.6% | 16<br>8.4% | | |
| | Distal Penile | 18<br>13.4% | 8<br>14.5% | 26<br>13.7% | | |
| | Mid Penile | 36<br>26.9% | 20<br>36.4% | 56<br>29.5% | | |

**Table 2**. Baseline operative parameters.

| Operative Parameters | | Layer Used: Dartos (n=135) | Layer Used: Tunica Vaginalis (n=55) | Total | Pearson Chi-Square: Value | Pearson Chi-Square: Asymp. Sig. (2-sided) |
|---|---|---|---|---|---|---|
| | Proximal Penile | 12<br>9.0% | 3<br>5.5% | 15<br>7.9% | | |
| | Penoscrotal | 33<br>24.6% | 12<br>21.8% | 45<br>23.7% | | |
| | Scrotal | 12<br>9.0% | 5<br>9.1% | 17<br>8.9% | | |
| | Perineal | 9<br>6.7% | 3<br>5.5% | 12<br>6.3% | | |
| Quality and Width of Urethral plate | Poor | 23<br>17.4% | 14<br>25.5% | 37<br>19.7% | 3.598 | .463 |
| | Intermediate | 93<br>69.7% | 31<br>56.4% | 124<br>66.0% | | |
| | Well Developed | 17<br>12.9% | 10<br>18.2% | 27<br>14.4% | | |
| Penile Skin Blood Supply | Good | 22<br>16.7% | 9<br>16.7% | 31<br>16.6% | 7.957 | .093 |
| | Intermediate | 15<br>10.6% | 6<br>11.1% | 21<br>11.2% | | |
| | Thin | 96<br>72.7% | 39<br>72.2% | 135<br>72.2% | | |

The overall complication rate for the whole study population was 32.1%, with 61/190 having at least 1 complication. The TVF group had 8 (14.5%) overall complication rate compared to the DF group 53 (39.6%), which are significantly different (p=.005). Of the 61 patients listed to have complications, 41 (21.6%) had urethra-cutaneous fistula. Four (7.3%) and 37 (27.6%) had urtherocutaneous fistula from the tunica vaginalis and dartos flap groups, respectively, representing a significant difference (p=.007). A total of 14 (7.4%) patients had meatal stenosis, 5 (2.6%) had meatal regression, 8 (4.2%) had skin flap necrosis, and 2 (1.1%) had residual chordee on post-operative follow up. There was no significant difference between the DF and TVF groups in terms of the said complications. Tables 3 and 4 summarize the complications.

## Discussion

Hypospadias is a relatively common condition, and the surgeon is faced by a tough reality that complication rates of repair were reported to be 1% to 50%.[30-32] And while there is no gold standard technique, all surgeries aim to reconstruct a penis that would be closest to normal-appearing, allow properly directed urine flow, and coitus and ejaculation. Hypospadias repair is a highly technical procedure, with complications arising even among the most experienced hypospadiologist. Of all complications, urethrocutaneous fistula is the most common complication in primary repairs, and may recur even after a careful re-do. Various methods and modifications have been employed to reduce fistula formation. In the earlier years, a

**Table 3**. Overall complication rates.

| | | Layer Used | | Total | Pearson Chi-Square | |
|---|---|---|---|---|---|---|
| | | Dartos (n=135) | Tunica Vaginalis (n=55) | | Value | Asymp. Sig. (2-sided) |
| Overall Complication | (-) | 82<br>60.4% | 47<br>85.5% | 129<br>67.9% | 11.662 | .003 |
| | (+) | 53<br>39.6% | 8<br>14.5% | 61<br>32.1% | | |

**Table 4**. Specific complications.

| | | Layer Used | | Total | Pearson Chi-Square | |
|---|---|---|---|---|---|---|
| | | Dartos (n=135) | Tunica Vaginalis (n=55) | | Value | Asymp. Sig. (2-sided) |
| Fistula | (-) | 98<br>72.4% | 51<br>92.7% | 149<br>78.4% | 9.809 | .007 |
| | (+) | 37<br>27.6% | 4<br>7.3% | 41<br>21.6% | | |
| Meatal/Urethral Stenosis | (-) | 122<br>90.3% | 54<br>98.2% | 176<br>92.6% | 3.630 | .163 |
| | (+) | 13<br>9.7% | 1<br>1.8% | 14<br>7.4% | | |
| Meatal regression | (-) | 130<br>96.3% | 55<br>100.0% | 185<br>97.4% | 2.146 | .342 |
| | (-) | 5<br>3.7% | 0<br>.0% | 5<br>2.6% | | |
| Skin Flap Necrosis | (-) | 131<br>97.0% | 51<br>92.7% | 182<br>95.8% | 1.822 | .402 |
| | (+) | 4<br>3.0% | 4<br>7.3% | 8<br>4.2% | | |
| Residual chordee | (-) | 133<br>98.5% | 55<br>100.0% | 188<br>98.9% | .845 | .656 |
| | (+) | 2<br>1.5% | 0<br>.0% | 2<br>1.1% | | |

2-stage operation where the hypospadias repair was buried in order to avoid fistula, has been described. [33] However, a second operation was necessary to complete the repair. A technique called "pants over vest", where one side of the shaft skin is de-epithelialized and then achieve closure has reported low fistula rates, but often, there is not enough ventral skin to achieve such maneuver.[7] The use of flaps, particulary vascularized pedicle flaps (preputial, scrotal dartos, meatal, tunica vaginalis) allow for a readily available and apparently effective barrier layer to reduce complications, particularly urethrocutaneous fistula.[20] Our series yielded an overall complication rate of 32.1% in 190 patients who underwent TIP following Snodgrass

description. The two groups in this study, however, showed a significant difference in complication rates, with the DF and TVF groups yielding 53/145 (39.6%) and 4/55 (14.5%), respectively (p=.003). Looking at the specific complications, there was no significant difference in meatal/urethral stenosis, meatal regression, skin flap necrosis, and residual chordee. However, the glaring difference between the 2 groups is in the most common complication reported in hypospadias repair, that is urethrocutaneous fistula. Our series report 41/190 (21.6%) overall fistula rate. But looking closer, the fistula rate for TVF group 4/55 (7.2%) is significantly lower than that of DF group 37/135 (27.6%), (p=.007)

The tunica vaginalis has an inherent vascularity, and several authors have cited the ability of tunica vaginalis to have adequate pedicle length which can be increased up to the external inguinal ring.[24] Therefore, it can be used to cover neourethra of varying lengths. The tunica vaginalis allows for a versatile and effective flap that is worth the effort harvesting when one contemplates its use during repair.

Perhaps the most challenging in hypospadias repair are those with more proximal meatal openings, which have high rates of complication and are technically demanding to reconstruct and achieve satisfactory cosmesis.[26] Due to its proximity to the defect, TVF can transposed easily and has the potential to cover relatively longer lengths of neourethra.[24,25] In this series, it should be noted that both the DF and TVF groups were equally used in all meatal locations.

Comparing DF and TVF groups, each have its proponents for use as the better second layer flap in hypospadias repair. In a series of 109 patients, the success rate of 98% for DF use was reported, where only 2 developed fistulas.[34] In another study, the success rate with TVF was 100% without a single complication.[27] In a study by Snow *et al.*, most of the post TVF complications were related to scrotal hematoma and abscess, while a rate of 5% was reported for urethrocutaneous fistula.[27] A randomized study utilizing Snodgrass method alongside DF in 20 patients and TVF in 29 patients as a second layer for hypospadias repair yielded fistula rate of 20% and 10% in the DF group and the TVF group, respectively.[35] In another series of 39 patients using TVF in re-do cases, rate of fistula was higher (20%) but the authors noted their inclusion of proximal and complex cases as reasons for the higher fistula rate.[26] In re-do procedures where vascularity of original tissues might be in doubt, several authors have likewise reported good outcomes with TVF use.[24,25] A more recent review, this time in a specific subset of midpenile hypospasdias underwent primary TIP repair showed TVF was superior to dartos flap in terms of fistula rate (8.3% vs 4.7%).[23] It is worth mentioning that in our series, the mean age of TVF group is older, albeit statistically insignificant, than the DF group (5.26 + 4.35 versus 4.97 + 4.14 years, respectively). Several reports have already acknowledged the higher rates of complications in older age at initial repair, and in general, our patients in both groups are older compared to current accepted practice of repair (6-24 months from birth).[36,37] It appears though that the TVF group in our series still had an improvement in the outcomes compared to the DF group which had patients repaired at an earlier age. Our results in this review is consistent with the maturing data coming out from the experience of surgeons using tunica vaginalis flap barrier layer.

## Conclusion

Snodgrass technique in combination with tunica vaginalis flap as a second layer appears to be a reliable and reproducible technique to improve complication rates, particularly urethrocutaneous fistula. Further experience in its utilization can potentially further improve future outcomes.

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