

Surgical Technique of Glans Wings Creation with Preservation of Glanular Vascular Arcade and Creating Flaps for Tension-Free Glansplasty in Hypospadias Repair

ABSTRACT

Objective: The objective of this study is to report the technical nuances of glans wings creation in anatomical plane facilitating liberal glans wings mobilization with preservation of glanular vessels for tension-free glansplasty in surgery of hypospadias in primary and redo cases.

Materials and methods: Eighty-six primary hyposapdias and 7 cases of distal hypospadias, operated elsewhere and presented with glans and urethroplasty dehiscence, undergoing tubularized-incised-plate (TIP) repair were included after ethical approval. Technical points of glans wings creation in the subfascial plane included (i) creation of Buck's fascia window, just proximal and lateral to the point of bifurcation of corpus spongiosum, (ii) creation of subfascial-pret unical plane on the tunica albuginea of corpora cavernosa up to ventral limit of laid open glanular meatus, (iii) release of pillars of corpus spongiosum off the glans base keeping the basal lamina propria covering the vascular arcade intact, (iv) release of glans base off the tip of corpora cavernosa and composite flap of corpus spongiosum pillars with Buck's fascia off the corpora cavernosa, (v) approximation of glans wings over the tubularized-incised-plate covered with dartos, and (vi) approximation of fasciospongioplasty flaps at hypospadiac meatus. Outcome measurement included (i) intra and postoperative problems and (ii) elimination of glans dehiscence.

Results: There occurred 1 injury to the tunica albuginea of ventral corpora cavernosa and 1 button-hole injury to subcoronal mucosal collars. Flaps for fasciospongioplasty were short in 11. One glans dehiscence occurred in flat glans.

Conclusions: This technique is effective in creating glans wings in the anatomical plane with the preservation of glanular vessels and flaps for fasciospongioplasty eliminating the possibility of glans dehiscence in both fresh and redo cases.

Keywords: Glans wing creation, glansplasty, hypospadias

Introduction

In surgery of hypospadias, the creation of glans wings is one of the essential steps for glansplasty with its ventral symphysis/raphe reconstruction without tension to prevent subsequent glans dehiscence. In addition, it is also an essential step for the reconstruction of glanular urethra and neomeatus at the tip of the glans. There are several published reports regarding the need and technique of glans wings creation with some of the papers emphasizing the need for extensive glans wings mobilization.¹⁻⁵ But, there is no report of pictorial demonstration of step-by-step surgical technique of glans wings creation in the subfascial plane serving the dual purpose of preserving the glanular vessels and creating the flaps for fasciospongioplasty supported by video. The purpose of this communication is to demonstrate the technical elaboration of nuances of glans

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Figure 1. (A) Proposed line of incision for glans wing mobilization and tubularized incised plate urethroplasty. Dorsal limit of laid open glanular meatus (1), ventral limit of laid open glanular meatus (2), junction of corona and open glanular urethral plate (3), hypospadiac meatus (4). Proposed line of incision proximally goes little beyond the hypospadiac meatus up to visible bifurcation of corpus spongiosum (5) distally incision stops 1 mm short of the ventral limit of laid open glanular meatus. (B) Penile degloving completed (ventral view) in the subdartos plane up to the root of the penis, showing bifurcated corpus spongiosum (5) proximal to hypospadiac meatus (4). Buck's fascia over the tunica albuginea of corpora cavernosa is to be picked up here for the creation of subfascial plane (6). (C) Few millimeters proximal at midshaft and few millimeters lateral to bifurcated corpus spongiosum, the Buck's fascia over the ventral aspect of tunica albuginea is picked and lifted off. The fold of Buck's fascia is incised parallel to the corpus spongiosum creating the window through which blue-colored tunica albuginea is seen (7). (D) Through the window of Buck's fascia in the subfascial plane, the tip of Micro Halstead artery forceps is advanced in the plane over the tunica albuginea, deep to bifurcated corpus spongiosum and in between the plane of basal lamina propria of glans fixed with Buck's fascia and the tip of corpora cavernosa.

wings creation in the subfascial plane serving the dual purpose of extensive glans wings mobilization with preservation of the glanular vessels and creating the additional flaps for fasciospongioplasty near the hypospadiac meatus.

MAIN POINTS

- Buck's fascia fuse with the basal lamina propria layer of the glans base to form a protective barrier.
- This protective barrier protects intraglanular vascular arcade.
- For raising of glans wings, the subfascial plane just below the Buck's fascia is entered at midshaft. Proceeding distally in this plane between the tip of corpora cavernosa and the glans base covered with a protective barrier helps in the creation of glans wings.
- Raising of glans wings using this space facilitates the liberal raising of glans wings, protects glans vasculature, and exposes distal-most segment of corpora for the subsequent anchorage of dartos cover.

Material and Methods

Patients

The technique described was applied in 86 primary cases and 7 cases with previous failed surgery with glans and/or urethroplasty dehiscence and referred to our center selected for tubularized-inc ised-plate (TIP) urethroplasty. Primary cases included 18 subcoronal hypospadias, 41 distal penile hypospadias, 16 mid-penile hypospadias, 8 proximal penile hypospadias, and 3 penoscrotal hypospadias with mild chordee correctable after penile degloving. Ethical approval for the technique was taken from the institution's ethical committee with approval number 7555/Ethics/R.Cell-15.

Surgical Technique

Including the hypospadias meatus, the distal glanular extent of a U-shaped incision along the proposed urethral plate margins is shown in Figure 1A, that is, distal limits of incision stop approximately 1 mm short of ventral limits of laid open glanular meatus on both sides (Figure 1A).

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The penile degloving was done in the subdartos plane up to the root of the penis and the bulbar urethra without the application of a tourniquet at the base of the penis (Figure 1B). The point of beginning of subfascial dissection was selected few millimeters proximal and lateral to the bifurcated corpus spongiosum. At this point, the Buck's fascia was picked up between 2 Micro Halstead artery forceps. Applying mild tension, shallow folds of the Buck's fascia were lifted off the ventral aspect of the underlying tunica albuginea of the corpora cavernosa. Using ultrafine needle tip cautery, folds of the Buck's fascia held between 2 hemostats were incised parallel to the corpus spongiosum facilitating exposure of the blue-colored tunica albuginea (Figure 1C). Through the window of the Buck's fascia thus created, another Micro Halstead curved artery forceps was inserted keeping the tip of artery forceps in close contact with the underlying tunica albuginea. Short dissection through the window by spreading the tip of artery forceps will increase the size of the window. This maneuver will also tease away the remaining fibers of Buck's fascia which might have been accidentally left adherent over the tunica albuginea at the time of the creation of the window. Through the window of Buck's fascia, keeping the tip of artery forceps in close contact with the vertical fibers of the ventral aspect of tunica albuginea, the artery forceps was gradually advanced toward the ventral aspect of glans corona adjacent to the urethral plate. Artery forceps was then advanced toward the point corresponding to the ventral limit of the laid-open glanular meatus (Figure 1D). The subfascial plane was thus created at the ventral aspect of subcoronal paraurethral shaft. A plane was also created in the potential space between the tunica albuginea of the tip of corpora cavernosa on one side and the barrier of the subglanular extension of Buck's fascia fused with the lamina propria of the glans base on the other side.⁶ The word of caution is that in this process of creation of the subfascial plane, any resistance to advancement of artery forceps was an indicator of advancement in the wrong plane, that is, we had not gone into the plane exactly above the tunica albuginea. Since the forceful advancement of artery forceps will result in loss of plane and injury of microvessels or corpora cavernosa and bleeding; therefore promptly after feeling of resistance, the Micro Halstead artery forceps was withdrawn and reinserted again and advanced keeping in close contact with the tunica albuginea. The tip of artery forceps being in the right plane, artery forceps could easily be advanced up to the point of the ventral limit of laid open glanular meatus. Approximately 1 mm proximal to this point, 1 mm deep and 1 mm long epidermal incision will facilitate delivery of fine tip of artery forceps through the window of the epidermis of glans (Figure 2A). Once the creation of the plane has been ensured by smooth insertion and obstacle-free advancement of artery forceps distally, which goes deep to the bifurcated pillars of corpus spongiosum, 1 blade of Reynolds Supercut scissors could be easily inserted through the window keeping other blade outside. Starting from this window and going distally step by step, the Buck's fascia lifted over the artery forceps was cut (Figure 2B). Further distally, the insertion of bifurcated pillars of corpus spongiosum was released off the glans base with a sharp cut in the correct plane protected by the artery forceps underneath (Figure 2C). Cut edges of the Buck's fascia medially and laterally were held by a series of artery



Figure 2. (A) Tip of artery forceps advanced distally in the correct subfascial plane deep to Buck's fascia and bifurcated corpus spongiosum. The fine tip of artery forceps is delivered through the epidermal window created just proximal to proximal limit of laid open glanular meatus. (B) Through the window of Buck's fascia, 1 blade of Reynolds scissors (Supercut) is inserted keeping the other blade outside. Buck's fascia is being cut. (C) Insertion of bifurcated pillars of right corpus spongiosum is being released from the glans base with Reynolds scissor. Artery forceps placed in the plane for the prevention of injury to other structures. (D) After the release of bifurcated pillars of corpus spongiosum, the medial and lateral edges of Buck's fascia are held with a series of artery forceps.



Figure 3. (A) After holding the cut edges of Buck's fascia on the medial and lateral side, traction and counter-traction expose the plane between the tip of corpora cavernosa and glans base which is being released by the tip of fine forceps, showing vessels to glans (8), coronal arcade (9), covered with barrier formed by fusion of basal lamina propria and Buck's fascia. Released bifurcated pillars of corpus spongiosum covered with Buck's fascia for fasciospongioplasty (10). Lifting of paraurethral edges of Buck's fascia with released corpus spongiosum without disturbing microvessels going to corpus spongiosum (11) and creating a triangular flap at hypospadiac meatus for fasciospongioplasty. (B) Flaps for fasciospongioplasty, double-breasted over the hypospadiac meatus after bilateral glans wings release. (C) After tubularized-incised-plate urethroplasty and dartos coverage, mobilized glans wings are approximated in midline creating symphysis glans and frenulum from the submucosal collar (12). (D) Postoperative appearance of glans, meatus, and subcoronal collar after 6 months follow-up.

forceps to further identify the plane (Figure 2D). At this step, some bleeding may be encountered from the divided pillars of corpus spongiosum which stops after short compression. Minute bleeding from the glans base after short compression could be controlled with microtip bipolar forceps. Divided edges of Buck's fascia on the lateral side and toward the urethral side were picked up with a series of Micro Halstead artery forceps. Mild tension exerted along the lateral side will expose the corporal-glanular interface at the base of the glans which was released with blunt dissection by the tip of forceps up to the tip of corpora cavernosa. This maneuver also exposes the basal lamina propria of the glans covering the basal coronal arcade and intraglanular vessels which are visible through the thin barrier of fused Buck's fascia with the lamina propria of glans base (Figure 3A). Similar traction exerted toward the paraurethral edge of Buck's fascia opens the plane between the tunica albuginea and the corpus spongiosum with urethral plate (Figure 3A). Running across the plane fine vessels are visible which are not disturbed (Figure 3A). This maneuver will create a triangular flap just parallel to the hypospadiac meatus comprising of the Buck's fascia, the tunica albuginea of the bifurcated pillars of corpus spongiosum which have retracted after release from the glans (Figure 3A). These flaps lie on both sides of hypospadiac meatus and can be double-breasted after TIP urethroplasty for provision of effective fasciospongioplasty which will effectively prevent fistula at this site (Figure 3B).

Tubularized-incised-plate urethroplasty was completed in 2 layers. While terminating the second layer toward glanular meatus, a small bite is also taken from adjacent glans base tissue before tying off the knot. This maneuver contributed to the prevention of glans dehiscence. After the provision of double dartos flap cover with intact vessels for neourethral coverage, we do not perform 2-layer glans approximation. Ensuring corona to corona alignment, ventral glans raphe is created with the help of single layer mattress suture which is effective in preventing the glans dehiscence and forming midline ventral glans symphysis similar to normal control. Between the aligned corona and the ventral limit of meatus, another transverse mattress suture is placed. Midline approximation of subcoronal mucosal collar helps to create a midline frenulum (Figure 3C). The penile skin cover is restored. The surgical technique can be understood with the help of the video submitted along with the manuscript (Video 1).

Outcome Measurement

Criteria for assessment of the technique and results were (i) intraoperative problems, (a) apart from the premeditated cutting of Buck's fascia, injury to any other structure, that is, urethral plate, subcoronal mucosal collar, intraglanular coronal arcade, corpus spongiosum, corpora cavernosa, (b) mobility of glans wings thus created facilitating tension free midline closure, and (c) vascularity/discoloration of

Presentation	Type of Hypospadias	Number	Occurrence of Glans Dehiscence
Primary cases	Subcoronal hypospadias	18	0
	Distal penile hypospadias	41	0
	Mid-penile hypospadias	16	0
	Proximal penile hypospadias	8	0
	Penoscrotal hypospadias	3	1
Redo cases presenting glans dehiscence and/or variable dehiscence of urethra	Subcoronal hypospadias	4	0
	Distal penile hypospadias	3	0

Table 1. Details of Types of Hypospadias in Both Primary and Redo Cases and Occurrence of Complications and Glans Dehiscence After Using

 Described Technique of Glans Wings Mobilization

the glans wings; (ii) problems in short postoperative follow-up, (a) appearance of glans and any complications including glans dehiscence, (b) occurrence of urethrocutaneous fistula at the hypospadiac meatus site; and (iii) success in elimination of glans dehiscence with this technique in.

Results

Tubularized-incised-plate repair with glans wings mobilization and glansplasty with the described protocol was completed in 86 primary cases and 7 redo cases. Primary cases included 18 subcoronal hypospadias, 41 distal penile hypospadias, 16 mid penile hypospadias, 8 proximal penile hypospadias, and 3 penoscrotal hypospadias with mild chordee correctable after penile degloving, Among 7 redo cases, primary repair was done elsewhere for 4 subcoronal hypospadias and 3 distal penile hypospadias, and all these redo cases presented with glans and/or ure-throplasty dehiscence (Table 1).

Out of 86 primary hypospadias, intraoperative problems/injuries were seen as (a) injury to tunica albuginea of corpora cavernosa repaired without further complication in 1, (b) button-hole injury in mucosal collar near subcoronal sulcus by misdirected advancement of artery forceps in 1, (c) difficulty in the advancement of artery forceps toward the tip of glans because of inappropriate plane subsequently corrected in 5, (d) inadequate flap for fasciospongio-plasty was seen in 3 penoscrotal hypospadias and 8 proximal penile hyposapadias; however, no fistula was seen in these cases (Table 2).

There was no bleeding from the coronal arcade; however, minute bleeding from the glans base after release could be stopped with compression in all. There was no difficulty in releasing the glans wings in the subfascial plane off the corpora cavernosa and its tip. However, releasing the divided corpus spongiosum and urethral plate off the corpora cavernosa was difficult in 8 proximal penile and 3 penoscrotal hypospadias. After urethroplasty and provision of neourethral coverage with penopreputial dartos flap, the glans wings could be adequately mobilized to be approximated in the midline without tension in all even including 10 patients having distal penile

Table 2. Details of Complications After Using Described Technique of

 Glans Wings Mobilization

Type of Complications	Number
Injury to tunica albuginea of corpora cavernosa	1
Button-hole injury to submucosal collar	1
Difficult advancement of artery forceps due to inappropriate plane	5
Inadequate flap of fasciospongioplasty	11

hypospadias with flat and/or small glans. There was no postoperative discoloration or a vascularity of glans. During follow-up at 6 months, esthetic appearance was satisfactory in all (Figure 3D) except in 1 case with penoscrotal hypospadias and small flat glans who presented with glans dehiscence during follow-up (Table 1).

In 7 redo cases, there was no intraoperative problem and difficulty in releasing the glans wings in all except in 1 in whom injury to tunica albuginea occurred and was repaired without complication.

Discussion

In normally developed penis, the glans cap is molded over the pair of the tip of corpora cavernosa similar to the cap of mushroom with external urethral meatus being at the tip of glans. Penile urethra continues as glanular urethra to open at the tip of glans as external meatus. Corpus spongiosum surrounding the urethra merges into the substance of glans. Ventral midline fusion proximal to external meatus is marked by symphysis glans further proximally continuing as frenulum and median raphe. Thus, the glans wings naturally embrace the glanular urethra terminating into ventral midline fusion.⁷⁻¹¹ In hypospadias, the base of glans cap, though intimately molded over the tip of corpora cavernosa, is separated from the tip of corpora cavernosa by the barrier formed by the intraglanular extension of Buck's fascia and lamina propria of the base of the glans.⁶ Case of hypospadias is marked by ventrally laid open urethra which in most cases may be transformed from cleft to shallow or obliterated urethral plate continuing distally as shallow glanular groove associated with variable degree of flattening of the glans. From the hypospadiac meatus, the cylinder of corpus spongiosum is converted into bifurcated pillars of flattened corpus spongiosum inserting into the glans base. Relevant details of surgical anatomy of this region in hypospadias have already been published describing the details of intraglanular vessels and fascial barriers.⁶ In reconstructive surgery of hypospadias, the creation of glans wings is a necessary step for the reconstruction of glanular urethra, creation of slit-like external meatus and creation of symphysis glans with the alignment of corona in the ventral midline for better aesthetic appearance. The necessity of glans wing creation and the techniques have already been described in the literature.¹⁻⁵ Exploitation of details of surgical anatomy⁶ for prevention of damage to glans wing, damage to vessels, and adequate mobilization of glans wings have not been adequately emphasized. Non-anatomical creation of glans wings may be associated with the probability of glans damage, vascular damage, and inadeguate mobilization leading to ventral glans approximation under tension over the neourethral coverage. It results in a higher risk of glans dehiscence

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due to approximation under tension or ischemia.¹² Creation of glans wings exploiting the facts of anatomy⁶ starting in the subfascial plane at the level of hypospadias or midshaft and releasing the bifurcated pillars of corpus spongiosum from the glans base is associated with several advantages, namely (i) it enhances the reproducibility of technical details and reduces the possibility of vascular accident, (ii) it enables the surgeon to perform extended glans wings mobilization with preserved vascularity under vision facilitating ventral tension-free glans approximation, (iii) it facilitates the creation of triangular fasciospongioplasty flap attached to hypospadiac meatus comprising of Buck's fascia and released corpus spongiosum from the glans base enabling the possibility of fasciospongioplasty which can prevent junctional fistula, (iv) it also helps in exposure of distal-most segment of corpora cavernosa so that well-vascularized double dartos flap can be easily anchored over tip of corpora without any tension to provide neourethral cover. Although, glans tilt is corrected to a significant extent with the described technique, but, even perfectly performed technique fails to correct preexistent anterior migration of external urethral meatus. This is the limitation of described technique. With this technique, good amount of tissue is available for fasciospongioplasty in vicinity of hypospadiac meatus for neourethral coverage. However, for coverage of subcoronal part of urethra, available issue is scarce and additional neourethral coverage will be needed. The disadvantage of the technique is limited. The intraoperative difficulties and complications were encountered only where strict adherence to technical protocol was defaulted. Complications once encountered could be subsequently eliminated in subsequent cases by following the technical protocol described. Therefore, the relevance of this article is also to disseminate the science and art of glans wings creation with a description along with the video. Nevertheless sticking to the technique described in this report one can almost eradicate the possibility of glans damage, vascular damage inadequate mobilization of glans wings, and the technique facilitates tension-free ventral approximation of the glans wings. Similarly, with the described technique of glans wing mobilization in the subfascial plane, wide and adequate glans wings can be raised both in hypospadias with small glans and failed hypospadias for tension-free glansplasty without any risk of glans damage or vascular damage. The technique is easily reproducible setting aside the craftsmanship and experience of the surgeon performing the glans wings mobilization. Analysis of our results with completion of successful glans wings mobilization and ventral approximation with an extremely low incidence of glans dehiscence even in cases requiring redo hypospadias repair has substantiated the utility of the technique. The weakness of this study is that group of patients included in the study is not homogeneous making it difficult to generalize the results. Glans wings creation in the anatomical plane between the tunica albuginea of corpora cavernosa and the Buck's fascia with described technical protocol is useful in creating liberal glans wings with the protection of intraglanular vessels and coronal arcade running at glans base protected by the barrier formed by fusion of basal lamina propria of the glans and the Buck's fascia. It reduces the possibility of glans dehiscence and also helps to create flaps for fasciospongioplasty.

Ethics Committee Approval: Ethical committee approval was received from the Ethics Committee of King George's Medical University, Lucknow, India (Approval no: 7555/Ethics/R.Cell-15).

Informed Consent: Written informed consent was obtained from the patients who participated in the study.

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Video 1: This video demonstrates the step-by-step technique of glans wings creation in the subfascial plane in a case of midpenile hypospadias. Incision lines, penile degloving, technique of creation of Buck's fascia window, development of subfascial plane, release of glans wings with preservation of glanular vessels in anatomical plane, and flaps of fasciospongioplasty and glansplasty over the tubularized and covered neourethra are shown. Video link: https:// youtu.be/kA91INIFcRY.

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