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Hypospadias repair with the glanular-frenular collar (GFC) technique

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Summary

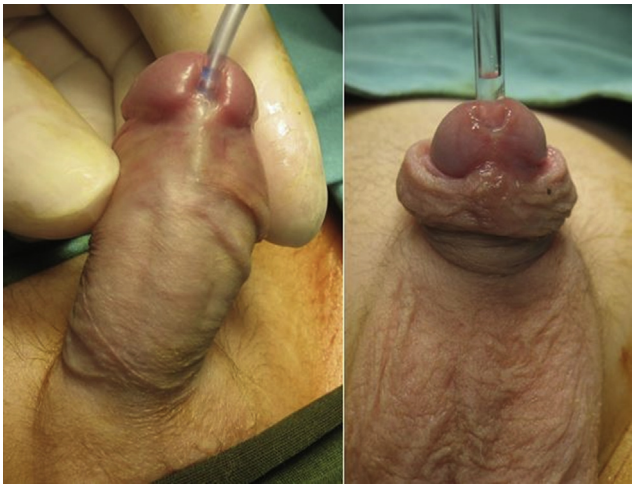
Background
In the normal human penis, the glans wings merge in the midline ventrally, but are separated by the 'septum glandis' in conjunction with the frenulum. The frenulum is also included in the formation of the distal (glanular and subcoronal) urethra, which has a special part known as the 'fossa navicularis'. This has inspired a hypospadias repair technique that simulates the development of the glanular and subcoronal urethra, which can be incorporated into the repair of all cases of hypospadias.

Material and method
A total of 121 patients with varying degrees of hypospadias underwent surgery with the described technique: a Y-V plasty was used to dissect the inner foreskin, in a fashion that allowed for its ventral mobilization as a frenular mucosal collar. After tubularization of the proximal urethra, a partial spongioplasty was performed that extended up to the subcoronal level. The glans wings were approximated only at their outermost convexities, with a couple of subepithelial sutures, leaving a slit for the meatus. The cleft-like area between the split wings of the glans penis was filled with the terminal ends of the spongiosum and the dartos of the mucosal collar, which converged to form a septum and a neo-frenulum (glanular-frenular collar, GFC). The midline skin closure of the ventral collar and the circumferential foreskin closure was completed as usual.

Results
At a mean follow-up of 10 months, two patients developed urethral fistula (2%), six had meatal stenosis (5%), and two had glans dehiscence (2%) that resulted in meatal retraction. Overall, patients had a cosmetically satisfying appearance (Figure). Forty-one received secondary circumcision; the parents of 80 (66%) patients were satisfied with the final foreskin appearance obtained with this method.

Discussion
The split wings of the glans penis or so-called ventral cleft between the glans wings that accommodate the frenulum is part of normal anatomy. Hence, in hypospadias surgery, the approximated glans wings should allow for ventral support of the glanular and subcoronal urethra through a reconstructed neo-frenulum. Neither glanular surface enhancement nor extensive dissection of the glans wings and their full-length approximation are necessary, and may in fact be counter-productive.

Conclusions
The employment of a GFC provided: 1) an anatomical restoration of the distal (glanular and subcoronal) urethra, supported by a frenulum; 2) a protective (undissected) dartos layer over the distal part of the tubularized neourethra; and 3) a space for the re-formation of the fossa navicularis.



Summary Fig Pre-operative and postoperative images of a patient operated with the GFC technique.1

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Introduction

In normal human penis anatomy, the glans wings are separated by a median partition (septum glandis) and a ventral cleft between the glans wings that accommodates the frenulum. The septum glandis is well-defined fibrous tissue that separates the two hemiglans and suspends the glanular urethra (fossa navicularis) between the sheath of the conical end of the corpora cavernosa and the frenulum of the prepuce [1—3]. In addition to a defective urethra and its corpus spongiosum, the frenulum is entirely missing in hypospadias. The foreskin is not fused ventrally; it appears as a hood over the glans penis. Recent studies have shown that masculinization of the urethral plate occurs in association with the growth and fusion of the preputial fold along the ventral midline of the genital tubercle, which also forms the frenulum of the proximal part of the glanular urethra [4—9]. Hence, it is clear that formation of a normal urethra, with its fossa navicularis, is an important indicator of an anatomical hypospadias reconstruction.

The described operative technique based on a glanular-frenular collar (GFC) was designed with an understanding of the abnormal urethral and foreskin development in hypospadias. The terminal ends of the bifurcated spongiosum and the dartos of the laterally-hooded inner foreskin were used as a ventral collar, thus emulating normal anatomy by creating a septum glandis and frenulum with a space to accommodate the fossa navicularis, which in general is not specifically addressed in urethroplasties. The preliminary reports were previously presented [10].

Materials and methods

Between 2010 and 2015, 121 patients with hypospadias (84 distal-to-mid penile, 37 proximal penile/penoscrotal), without severe chordee (<45°) underwent the GFC technique by one surgeon (HÖ). In all patients, urethral plates and hooded foreskins were present at a sufficient level for a primary repair with tubularized incised plate (TIP) incorporated with GFC reconstruction.

Surgical technique

The operation routinely started by specifying the anatomical landmarks of the foreskin and penis. Two holding sutures were placed on the edges of the 'dog-ears'. By elevating these sutures, the angle of the inverted V-shaped foreskin was changed from downwards to upwards, forming the arms of a 'Y'. The initial incision was performed between these two holding sutures on the naturally occurring linear border between the inner and outer forekin, ending on both sides of the hypospadic meatus. The leg of the 'Y' was formed with a vertical midline incision on the inner foreskin, and a third holding suture was placed at its end (Fig. 1A and B). Extreme care was taken while dividing the dartos layer, in order to preserve it for both the inner and outer foreskin layers. The vertical midline incision facilitates subsequent ventral rotation and midline approximation of the inner foreskin as a ventral collar in the form of the frenulum.

A ventral 'U' incision around the hypospadic meatus was performed, and the arms of the incision were extended towards the glans wings along the urethral plate. The glans wings were incised up until their outermost prominent convexities (glans monticuli). Degloving below the meatal level was performed as required in order to find and release the diverted corpus spongiosum. A tubularized incised plate (TIP) repair and partial spongioplasty that extended up to the subcoronal level (using subepithelial 7/0 polydioxanone) were performed in all patients. The terminal ends of the displayed and bifurcated corpus spongiosum at the glanular and subcoronal level and the dartos of the ventral preputial collar were dissected carefully (Fig. 2).

The glans wings were approximated only at their outermost convexities, with a couple of subepithelial (6/0 polyglactin) sutures, which left a slit for the urethral meatus. At the mid-frenular level, the ventral collar was approximated in the midline with a full-thickness suture (6/0 polyglactin). By suspending this suture superiorly, a cleft-like area between the wings of the glans penis was exposed. This cleft-like area was filled with the terminal ends of the spongiosum and the dartos of the mucosal collar (using 7/0 polydioxanone sutures), which converged to form a septum and a

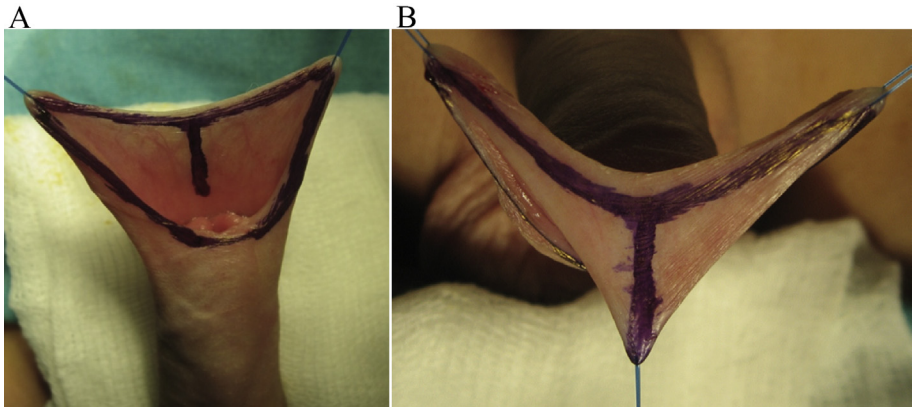

Figure 1 **A and B.** A 'Y' incision dividing the outer and inner foreskin, which facilitates ventral rotation of the latter as a ventral collar. The dartos layer is preserved for both the outer and inner foreskin layers.