One Step or Two Steps for Complex Hypospadias Forms: An Ongoing Dilemma

FROM THE GUEST EDITOR

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Hypospadias repair is one of the most exciting issues in our subspecialty due to the highly variable clinical presentations. Despite numerous advances in tissue transfer and refinements in operative techniques, there is seldom a consensus when two or three pediatric urologists sit together to discuss their preferable approaches. Preferences may vary in topics such as using grafts versus flaps, types of stents, urinary diversion and the polemic issue of treating in one or two steps.

Complex primary hypospadias repair is the main subject of this special edition of Dialogues in Pediatric Urology. We invited herein some of the most recognized experts to present their own concepts and preferences and to explain why they think that their “way of treating” is better. One aspect that most authors agree on is the importance of preservation of the urethral plate whenever possible. When ventral curvature is severe, a few surgeons will make additional efforts to preserve the plate while others will cut it and then decide between reconstructing the urethral plate with dorsal grafts and going on to a two-step strategy.

I hope you enjoy the discussion and may the content here help you find your own “way” every time you are confronted by a difficult case of primary hypospadias.

FROM THE EDITOR

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Proximal hypospadias continues to be a challenge for the pediatric urologists. Even in the best of hands re-operation numbers are significant. My advice to the young pediatric urologists is to become familiar with several different techniques and work with them and even modify them to a point where you feel comfortable with most anatomical variations that may dictate the type of repair you do.

This issue is a true dialogue. It represents contrasting opinions on one stage repairs versus two stage repairs for complex hypospadias. Each of the authors has a significant experience in proximal hypospadias and most have gone through circuitous route in hypospadiology to get to where they are today. As you read through the various repairs you will see that no one repair stands out as having the highest success rate. You will also note that all of these authors are quite honest in reporting their results. Proximal hypospadias repair calls for the ability to assess the individual anatomy and tailor your operation accordingly. It takes imagination and a desire to try new techniques.

Dr. Macedo and his contributors have put together a classic dialogue in pediatric urology covering the spectrum of complex hypospadias repair. They are to be congratulated.

This will be the last issue of the Dialogues in Pediatric Urology that will appear in hardcopy. Due to increasing cost and decreasing industry support, the Executive Council of the Society for Pediatric Urology has decided to continue the Dialogues in Pediatric Urology with the online version only. Should the economic environment change in the future we hope to be able to present Dialogues in the hardcopy again.
Rationale for the Treatment of Complex Hypospadias Forms

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The treatment of hypospadias is both a science and an art with surgical innovation and flexibility being key components for a successful outcome. The goal of hypospadias surgery is to have a functional penis with normal voiding and near as possible cosmetic results mimicking a normal phallus. It has become self-evident that patients (and parents) are willing to accept more than one operation to obtain a durable, functional, and cosmetically acceptable outcome. I believe that a controlled two-stage operation is always a better option than unexpected complications from an overextended single stage repair.

Complex hypospadias comes in many varieties. My algorithm for the treatment of complex hypospadias applies to all hypospadias surgery (Figure 1). When possible a single stage repair is employed, with the caveat that the patient and family as well as surgeon must be prepared for a controlled two-stage operation when the local factors preclude a one-stage surgery. The two key factors that drive a one versus two stage repair are: 1) the need for repair of penile curvature, which may lead to the resection of the urethral plate, and 2) the amount and quality of the available skin for both the urethroplasty and subsequent skin coverage of the penile shaft.

Patients with virgin severe hypospadias (Figure 2) may have both of these factors. In cases of severe penile curvature that requires resection of the urethral plate (Figure 2C) with ventral grafting (dermis or tunica vaginalis) a simultaneous urethroplasty is an unwise choice. Time has shown that even in the most experienced surgical hands the use of a complete tubularized island preputial flap urethroplasty yields poor results with an extremely high chance of reoperation secondary to diverticulum formation.

I have found the finger test (Figure 3) a useful technique to determine whether the dorsal midline plication will be successful for penile straightening or in the rare but more severe cases of curvature, whether resection of urethral plate and ventral grafting is necessary. The finger test is performed after a complete dissection of all tissue along the corporal bodies to the penile scrotal junction. In the rare case when the urethral plate is short or poorly developed it is also resected (in my hands necessitating a two stage repair). Artificial erection with injectable saline and a 25-gauge needle along with a tourniquet at the base of the penis will allow assessment of the degree of penile curvature. With the penis in the erect state, if it is not easily pliable to a straight position as illustrated in Figure 3B, then midline dorsal plication is not appropriate for correction of penile curvature. Figure 3C shows the completed repair in a penis that had a positive finger test where the curvature was easily corrected by using the midline dorsal plication with two 5-0-prolene sutures placed at the 12 o’clock position at the point of maximum curvature.

In virgin severe hypospadias, the amount of available dorsal hooded foreskin may also be a limiting factor (Figure 2A). If the foreskin is underdeveloped, enough skin may not be available to form a functional onlay flap.

I have also found the algorithm (Figure 1) useful for patients who have had multiple surgeries with resultant complex hypospadiac anomalies. Figure 4 is an example of this type of patient with a proximal opening, a long skin bridge, a fistula, a diverticulum near the hypospadiac urethra at the penoscrotal junction and significant ventral skin scarring especially at the coronal margin. The initial maneuver in this patient was to excise the skin bridges and preserve the redundant urethral plate. The coronal ventral scarring was excised and the redundant urethral plate advanced into the glans. The urethral plate was (continued on next page)
primarily tubularized and covered with de-epithelized subcutaneous pedicle flap (Figure 4B). Preoperative counseling was clear in that a two-stage repair was to be expected, however, at surgery, the amount of available skin, and subcutaneous tissue allowed the patient to be repaired in one stage (Figure 4C).

Patients who have had multiple previous surgeries with excessive scarring and a paucity of ventral skin are best treated with a two-stage “Bracka” buccal inlay graft at the first stage to augment needed skin for the urethroplasty. At the second stage, performed at least 5 months later, urethroplasty protection can be difficult with little available subcutaneous tissue. In this situation (Figure 5), I do not hesitate to take advantage of a tunica vaginalis graft (Figure 5B, arrows) to protect the urethroplasty, adding protection, and protecting fistula formation in patients with complex redo surgery (Figure 5C).

Patients with severe hypospadias may also have associated penoscrotal transposition of a more severe variety. Mild penoscrotal transposition rarely needs to be aggressively reconstructed, because at puberty this defect becomes essentially a non-issue secondary to pubic hair. Although rare, I have found a few situations where a three-stage approach is a logical and successful option. In this case (Figure 6), in the first stage penile curvature is corrected. In the second stage the urethroplasty is completed and in the third stage, the correction of the severe penoscrotal transposition. Ultimately, our outcomes will be judged on a normal cosmetic appearance and a functional and durable urethra without diverticulum, stricture, fistula, or hair bearing tissue.

In conclusion, complex hypospadias surgery requires attention to surgical detail and flexibility in respect to surgical procedures. I would not hesitate to perform a controlled two-stage surgery if: 1) penile curvature is not simply corrected by dorsal midline placation, requiring resection of the urethral plate with ventral grafting, and 2) adequate normal skin and subcutaneous tissue is lacking. I follow the algorithm (Figure 1), which I apply to all types of hypospadias surgery with the stated goals of long-term functionality and a normal cosmetic appearance.

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**Why Treating in 2 Steps is Often Better**

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**Introduction**

There can be little doubt that in terms of convenience and cost, single-stage solutions are inherently attractive for hypospadias correction. Indeed during the Duckett era it became almost unthinkable that stage repairs might ever be resurrected. The available armamentarium of 1-stage repairs can in principle correct all degrees of hypospadias, even the most proximal forms, to achieve a straight penis with an apical meatus.

Currently it is fashionable to try and preserve the axial integrity of the urethral plate, which can be augmented either dorsally with a Snodgrass TIP, or ventrally with a preputial onlay flap. However this may not be feasible in severe proximal forms of hypospadias when associated with a short tethered urethral plate and marked chordee.

In such cases it may be necessary or better to transect the urethral plate, and thus create a full circumference urethral substitution.

What are the relative merits of achieving this with 1-stage flaps, 1-stage tubed grafts or 2-stage graft repairs?

**1-stage flap repairs**

Asopa/Duckett 1-stage tubed prepubic island flaps (TPIF) enjoyed widespread popularity during the 1980s. In complex perineal hypospadias the TPIF procedure cannot always create a long enough tube that is adequately vascularized at its extremities. Adding the TPIF onto a Duplay tubing of the proximal plate is one solution, but adds an extra anastomosis and may introduce hair bearing tissue in the proximal part of the urethroplasty. More radical and complex 1-stage tubed flap repairs such as the Koyanagi have, therefore, found favour in some quarters as a way of producing long enough tubes for the most proximal cases. To achieve this extra length of neo-urethra, ventral peno-scrotal skin is incorporated along with the inner prepuce, so there is again a potential for urethral hair in adult life. Furthermore the design of the flaps requires a commitment to the procedure from the very outset.

Little or no long-term follow-up has meant that patients have been discharged before they were old enough to feel any concern about poor meatal aesthetics, junctional strictures, rotation deformities, and subsequent dilatation of the unsupported skin tube. Add to that the potential for urethral hair growth later in adult life for those procedures that incorporate shaft or scrotal skin into the repair.

A degree of aesthetic compromise of the glans/meatus configuration may seem a trivial price to pay for achieving the benefit of 1-stage convenience, but long-term reviews show that teenagers and young adults often regard the aesthetic outcome to be as important as the functional correction 1,2. This cosmetic aspect is assuming ever greater importance as the modern Western male is increasingly in pursuit of the perfect body image. Witness the flourishing market in male cosmetic surgery, beauty products and fragrances that would have been unthinkable just a few decades ago.

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1-stage graft repairs

1-stage tubed free grafts have never enjoyed widespread acceptance. They share the cosmetic issues associated with the flap repairs and have the additional problem of a prohibitive complication rate. Fifty percent re-operation rates are not unusual.

2-stage graft repairs

Why consider the 2-stage graft alternative? The author developed such a procedure back in the mid 1980s and for over a decade used this as a universal repair for most hypospadias. In the mid 1990s, an audit of 600 consecutive cases (of all severities) showed this method to be versatile, simple and safe. During that era this method had the advantage of offering better cosmetic and functional refinement than could be expected from the ubiquitous flap repairs that were in vogue at the time.

Although the TIP and graft augmented TIP (“Snodgraft”) repairs are now able to achieve comparable refinement in a single stage when the axial integrity of the urethral plate can be maintained, for those cases where the plate has to be divided, then the 2-stage repair still remains an excellent option. Indeed, in recent years, straw polls at international symposia have shown increasing uptake of this method for use in severe forms of hypospadias. Below are a dozen reasons why the reader might consider a 2-stage graft urethroplasty in preference to a 1-stage flap repair.

Advantages:

1) Two-stage graft urethroplasty is technically less demanding than tubed island flap procedures. Being inherently simpler in execution than the flap repairs, it can be used safely, not only in specialised paediatric centres, but also in general hospitals, in third world environments, and by trainees.

2) There is never a concern about finding enough tissue for reconstruction of even the longest defects. Usually the inner layer of the foreskin provides sufficient graft. The elasticity of the foreskin means that by harvesting the full width of the inner prepuce, this can then be stretched out to into a longer and narrower graft that is usually of adequate dimensions to create the requisite length of new urethral plate. If the foreskin hood is poorly developed or the patient has suffered the misfortune of a previous circumcision, this would create major problems for the surgeon who uses flap repairs. With this technique, however, it is not a problem because alternative graft sources such as oral mucosa or post-auricular skin grafts can be used in addition to, or instead of prepuce.

3) This inherent versatility also makes this the ideal technique for full circumference urethral substitution in re-operative salvage surgery where flap procedures may no longer be feasible. Although such patients are usually already circumcised, a hairy, a badly fibrosed, or a lichen sclerosus diseased urethra can easily be replaced using oral mucosa.

4) Being able to use the same technique for both primary and salvage surgery (in the latter situation it may be the only realistic option) means fewer procedures to master. A larger experience with one versatile method, leads to more rapid progress along the learning curve and, therefore, better results.

5) Familiarity with this method means that it is easy to master the other 2 repairs that are essential to the hyposiologist’s armamentarium. Thus a TIP repair is essentially the same as the 2nd stage procedure with just the addition of a dorsal midline releasing incision in the urethal plate. Likewise familiarity with the 1st stage grafting procedure makes the “Snodgraft” (graft augmented TIP variant) a straightforward proposition. These 3 simple repairs are technically closely related and form a natural progression of procedures with which it is possible to repair almost any primary or re-operative hypospadias problem.

6) Because this method does not incorporate scrotal or penile shaft skin into the new urethra, there is no risk of urethral hair problems developing in later adult life. Furthermore, in the author’s experience, irrespective of whether preputial Wolfe grafts, post-auricular Wolfe grafts, or oral mucosa grafts are used in the reconstruction, the new urethras develop normally during the rapid adolescent growth spurt.

7) Unlike 1-stage options that try to avoid transaction of the urethral plate and often resort to dorsal shortening procedures to straighten the penis, this method allows full ventral dissection of the corpora and reduces the need for Nesbit procedures, thereby optimising available penile length.

8) The graft-formed new urethral plate is well fixed to the corpora and has more back-up than that of a tubed skin flap. Megalouretrethra with problems of post-micturition dribbling of urine, and retained ejaculations in adult life, appears to be a common problem with 1-stage preputial flap urethroplasties. As an early complication, megalourethra may be due to the common difficulty surgeons have in estimating the correct flap width for the new urethra. In the longer term these complications may develop because the tighter terminal glans portion of the tubed flap leads to relatively high voiding pressures, with subsequent dilatation of the lax, poorly supported neo-urethra proximal to the glans. Although there is no published comparative data available, it is the impression of the author (who follows his patients through to maturity) and others who use the 2-stage graft method, that these problems are inherently less common with graft urethroplasties.

9) It is easier to design a neo-urethra of ideal and even calibre, and to minimise the risk of junctional strictures. The urethra is fashioned from a wide, grafted urethral plate that has already had 6 months in which to mature, to complete any variable contraction that might occur, and to acquire a stable blood supply. Allowance is made for any contraction that might take place, by making the graft a little wider than required at the 1st stage. Surplus width can be discarded at the 2nd stage. If, because of unfavourable healing, significant chordee remains or the grafted new plate is deemed to be unacceptable for tubing, then there is the opportunity to modify the plate before proceeding to the 2nd stage.

10) Cosmesis is typically better than with flap urethroplasties. A natural looking meatus can usually be achieved. During the 1st stage grafting procedure, the surgeon avoids placing sutures across the glans-graft junction, relying instead on the tie-over dressing to ensure graft fixation to the glans in the vicinity of the meatus. Because the new urethral plate within the clefted glans, and hence the meatal margins, is already stable come the 2nd stage, a neat vertical slit meatus of predictable size and devoid of suture marks can be safely fashioned.

11) Glans anatomy, and hence urinary stream, are more normal. A natural glans urethra consists of urothelium firmly fixed to the underlying glans sponge, an anatomical feature most closely replicated by a graft rather than flap urethroplasty. A flap urethroplasty introduces gliding areolar tissue under the glans urothelium, thereby, potentially producing unwanted mobility of the terminal urethra. Introducing this extra flap bulk may contribute to a more constricted glans urethra and higher voiding pressures. Achieving a smooth symmetrical meatus and stable terminal urethra minimises the risk of urinary spraying. Spraying and misdirection of the urinary stream are very uncommon features in the patients that the author has personally followed through to maturity.

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Indeed such symptoms are regarded as an indication for further investigation.

12) Unlike some of the alternative flap options, the 2-stage graft repair does not have to be pre-judged from the outset. For the surgeon who wishes to explore a 1-stage plate augmenting option such as an extended TIP in the first instance, the 2-stage repair can be used as a fallback option should preservation of the plate prove to be unsatisfactory.

The Use of Flaps in Complex Hypospadias

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I. Introduction: Rational for One-Stage Repair

The basic rationale for a one-stage repair of hypospadias is that there is always sufficient well vascularized tissue and skin for a primary repair. In the last 25 years one of us (HMS) has never found a primary hypospadias case, regardless of how severe, that could not be repaired with a one-stage repair with always excess skin to be discarded at the end of the case. A knowledge of the vascularity of this anomaly is critical to being able to carry out a one-stage repair. However, the vascularity is consistent and reliable and once a familiarity with it is gained, the vascularity permits a quite extensive case to be done safely with reliable good functional and cosmetic results.

The dorsal hooded prepuce is consistently supplied with four small arteries which are the terminal end of the pudendal system. By carefully protecting this pedicle during mobilization of the pedicle it can easily reach to the ventrum for a transfer of a island pedicle flap. Indeed the island pedicle can be used even more posteriorly and has been utilized to repair a bulbar stricture.

The key to understanding the preservation of the spongiosum is to realize it inserts into the skin just immediately lateral to the urethral plate as well as into the corporal bodies. To preserve the spongiosum for incorporation in hypospadias surgery requires dissection lateral to the insertion of the spongiosum into the skin to elevate the ventral skin which then permits a sharp division of the attachment of the spongiosum to the skin in a dissection plane immediately parallel to the intrinsic blood supply of the outer skin. This division usually is easiest if started proximally. By careful dissection of the spongiosum in this fashion, an excellent spongiosum can be consistently preserved for later incorporation in the hypospadias reconstruction.

The third aspect of vasculature in hypospadias surgery is the realization that the intrinsic blood supply to the penile skin, if carefully preserved, is adequate to support the blood flow to the skin of the entire shaft. The key to protecting the intrinsic blood vessels of the skin is to keep the dissecting scissors parallel to the outer skin so that the scissors tips do not damage the intrinsic vessels. In this way the outer skin can be reliably preserved and can be used accordingly for the design of an adequate skin fit at the end of the case.

An excellent cosmetic result from a one-stage repair depends on a combination of factors. First, is the design of the glansplasty. That ensures the formation of a slit-like meatus on a conically reconstructed glans as described below. Second, a generous dorsal to ventral skin shift must be designed so that there is symmetry of the amount of skin left covering the repair at the completion of the case dorsal to ventral and right to left. Any irregularity in skin design here will result in a lopsided-looking penis and inadequate result. We continue to very carefully and always measure the amount of skin to be left. Next, the importance of a well-designed skin fit at the penoscrotal junction must be emphasized. There must be a snug skin fit at the base of the penis so that there is a well defined step off at the junction of the penile shaft with the scrotum. If this is not made properly, the base of the penis will look like a pyramid and there will be a poor cosmetic result. The use of Firlit skin flaps can be a routine part of these repairs and gives a normal mucosal collar to the ventrum of the penis improving skin fit and appearance. If there is a cleft scrotum, this can be corrected by lateral dissection after the primary incision to expose the tunica vaginalis on each side. In doing this, all the vertical tethering bands that create the cleft scrotum will be divided. Any abnormal remaining shiny skin that is not healthy rugated scrotum should be excised before a careful everting closure of the scrotum is carried out. In this way, a cleft scrotum can be consistently reliably repaired. Lastly, we would emphasize that the use of subcuticular interrupted sutures is the only way we know to prevent the development of suture sinuses. Often suture sinuses, which reflect the rapid ingrowth of genital epithelium along sutures which transgress the surface, do not become evident for many years until patients become pubertal and have more sebum and dirt in the sinuses that make the (continued on next page)
them evident. Since we started utilizing subcuticular suturing just under 20 years ago, the cosmetic results have been much better. Initially the wound also looks much less inflamed because of the smaller amount of inflammatory producing suture material which is left near the skin.

II. Specific Techniques: Island Tube Repair

Although the island tube repair pioneered by Harry Asopa and then developed and popularized by John Duckett was our most common technique for severe hypospadias in the early 1980’s, today it is rarely used. This is because we realized in the mid 1980’s as the island onlay technique was developed, that in only about 10% of the most severe hypospadias cases is the urethral plate actually truly short and requires division. The technical points that make the island tube repair successful can briefly be summarized. First, it is important to avoid excess epithelium being incorporated in the tube. The inner prepuce as it is formed into a tube has to be carefully stretched to avoid incorporating excess skin. Generally for an infant only 12 to 14 mm of epithelium is tubularized. Interrupted sutures creating an inverting anastomosis of one skin edge to the other permit the tube to be stretched. The proximal anastomosis of the tube to the native urethra should be spatulated widely and the anastomosis tacked down with tethering corner sutures that catch the tunica albuginea of the corporal bodies as well as the tube and native urethra with spongiosum support. When it was realized this step was important, we significantly reduced the number of proximal anastomotic strictures that we saw. The suture line is always rotated so that it is buried against the corporal bodies which helps to decrease the likelihood of a fistula. The island tube is routinely covered by bringing pedicle tissue over it with a few tacking sutures on the far side of the transferred pedicle. The Firlit skirt flap soft tissue support, as it is brought to the midline in the final stages of reconstruction, also helps to bury the suture line. The rotational glansplasty contributes further by creating a broad surface of glans which separates the reconstructed urethra from the surface of the repair. Lastly, in forming the meatus it is important to try to avoid a circular anastomosis and if one is carried out to remember that wound contracture will tend to make a circular suture line smaller and accordingly, if meatal stenosis is going to be avoided, the meatus will need to be made appropriately larger.

III. Specific Techniques: Island Only Repair

In general after the ventral skin is dropped back the urethral plate measures 5 to 6 mm in width in a small infant. Accordingly, only a 1cm wide onlay flap is required to complete the substitution urethroplasty. Indeed it is imperative to avoid excess epithelium being introduced if the formation of a diverticulum is to be avoided. At each end of the design of the onlay flap, it should taper as there is no need for extra epithelium at the proximal anastomosis and as distally the size of the meatus at the apex of the ventral glansplasty is determined by the dorsal tissue rearrangement as described below in the design of a glansplasty. Leaving too much neourethra distally can lead to distention and kinking at the glans edge to create the physiology of an anterior urethral valve, which in turn will then lead to the formation of a sizeable urethral diverticulum. After the design of the onlay flap, it is sutured into place beginning with the suture line beneath the pedicle utilizing running 6-0 polydiaxanone suture. The monofilament suture helps to avoid the frustrating drag through the tissue that is seen with braided sutures. These sutures are usually placed from inside the native urethra outward in order to facilitate gathering up a generous bite of the supporting spongiosum. As the suture line is completed distally the glans should be drawn together setting up the first stitch of the glansplasty at its ventral apex. Before glansplasty reconstruction is begun, redundant tissue from the pedicle is tacked over the suture line as mentioned above which helps to avoid fistulas.

IV. Design of a Glansplasty

This is one of the aspects of hypospadias surgery which has been least well described in operative technique articles. It is critical to the creation of a good cosmetic result and the avoidance of meatal stenosis. The determination of the apex of the ventral glansplasty is the single most important initial decision that must be made as the hypospadias surgery is designed for an individual case. This point is where the flat ventral surface of the glans begins to curve around the meatus. If holding stitches are placed in the corners of the dorsal foreskin, in the majority of patients the insertion of the foreskin into the glans will show where the flat surface can be traced up to the point where it begins to curve around the meatus. If the apex point on each side is held with a forcep, then the amount of epithelium that will be within the meatus can be easily determined. If this is less than 14 to 15 mm then an incision in the dorsal plate will permit secondary epithelialization of this area to lead to an adequate meatus and the avoidance of meatal stenosis. The size of the meatus is usually adequate if a groove 12 to 14 mm is designed in an infant and up to 25 mm for a teenager who is more mature. Credit should be given to Warren Snodgrass for the recognition that the closure of this vertical incision that we used to advocate is not necessary. Secondary epithelialization occurs rapidly and gives a more normal slit like configuration to the meatus. In creating the subcoronal incision that will define the inner mucosal collar which will be part of the final skin reconstruction, today we routinely use the ventral skin flaps as described by Firlit in 1987.

The glans wings on each side are elevated carefully maintaining a dissection plane just above the insertion of the spongiosal into the glans to avoid severing the spongiosal attachments into the glans which will, if that occurs, result in a shortening of the spongiosum support for the urethral plate. The glans wings are mobilized keeping the scissors tips carefully parallel to the corporal bodies and mobilizing the glans adequately to permit a comfortable rotation around the urethroplasty. As the glans vasculature in hypospadias is dependant on the dorsal vascular bundle, there is no danger of devascularizing the glans as it is ventrally mobilized. After the completion of the urethroplasty, the glansplasty is then completed by rotation of the mobilized glans wings over the urethroplasty with interrupted hormonal mattress sutures. In the first year of life, 6-0 polydiaxanone sutures are used and in children over a year of age usually 5-0 vicryl. The sutures are placed parallel to the surface of the glans and 2 to 3 mm below the cut edge of the flat glans surface. As these sutures are tied this completes the rotation of the glans into a conical configuration that was aborted embryologically. A second immediately subcuticular Maxon layer ensures a smooth approximation of the glans edge and should result in an almost imperceptible eventual midline scar. As the glanuloplasty is completed it will bring to the midline the Firlit skirt flaps that were part of the initial design. The skirt flaps are then sutured in place with interrupted subcuticular sutures.

V. Skin Closure

For an excellent cosmetic result, it is important that the surgeon not let down his guard at this critical step. No matter how well the urethroplasty is carried out, if the skin fit is not an excellent one at the (continued on next page)
end of the case, the family will be displeased with the result. The dorsal preputial skin is split in the midline after the ventral penoscrotal junction point has been determined and constructed. This is important because once the penoscrotal junction has been clearly defined ventrally, then the amount of skin that will cover the shaft of the penis ventrally can be determined and matched dorsally. After the appropriate skin split dorsally, then a slide-around step moves the penile skin ventrally for a midline closure. A midline closure is almost always possible and creates the illusion of a normal penile ventral midline raphe. Great care is taken as this step is carried out to ensure by precise measurement that the skin fit dorsal compared to ventral and right compared to left is perfect. Any asymmetry will unduly compromise the surgery. There is always excess skin that has to be trimmed and then the closure is completed with further interrupted subcuticular 6-0 Maxon sutures.

VI. Ancillaries

We routinely use 1% xylocaine with epinephrine infiltration in the area of surgery. This helps to separate the tissues for more accurate surgical planes and also provides an element of hemostasis. We do not under any circumstance use a tourniquet around the penis as if careful attention is paid to the vascular anatomy as has been described above, there simply will not be any significant bleeding during the case. Any substantial bleeding in a hypospadias case reflects usually either getting into the spongiosum ventrally or into the pedicle dorsally. All our cases do also receive regional block anesthesia and are done on an outpatient basis regardless of the severity of the hypospadias or the length of the reconstruction.

A 6 French silastic intra-urethral stent is our preferred bladder drain. This material can be obtained from the manufacturers of the ventriculo-peritoneal shunt tubing inexpensively which we then divide into 15 cm long pieces, package and sterilize in 100 cm segments. The cost ends up being about $2.50 per stent. When the stent is placed, a few extra small holes at the bladder end ensure good drainage. The stent is left protruding from the urethral meatus a couple of centimeters and a Prolene suture is taken through the stent and placed through the inner surface of the meatus with a good generous bite of the glans on each side to secure the stent in place. By keeping the Prolene suture within the meatus, ugly punctate scars on the surface of the glans from the holding suture are avoided. Generally the stent is left in place for 12 to 14 days, but in a major scrotal hypospadias repair, the stent may be left in as long as 21 days. It is important to emphasize that in doing a complex case, the placement of the stent as the island tube or island onlay repair progresses early is very helpful, as in those cases there is simply will not be any significant bleeding during the case. Any substantial bleeding in a hypospadias case reflects usually either getting into the spongiosum ventrally or into the pedicle dorsally. All our cases do also receive regional block anesthesia and are done on an outpatient basis regardless of the severity of the hypospadias or the length of the reconstruction.

The dressing we use was devised by John Duckett many years ago and is referred to as sandwich dressing. Two pieces of telfa are placed against the penis dorsally and ventrally. Then small pieces of gauze are placed dorsally and ventrally and last Tegaderm is used to hold the penis down against the abdominal wall aimed at the umbilicus. The stent which carefully is kept out of the Tegaderm dressing is directed upward.

For postoperative care, we emphasize to the family giving abundant fluid to drink as it is only dehydration and amorphous phosphates in the urine that have caused these stents to become obstructed. The dressing is typically left in place for 36 hours and then the Tegaderm teased off and the rest of the dressing soaked off in a comfortable tepid tub. Subsequently, the child’s only care is to be placed into a comfort-

References


Other Selected References

The main determinant for urethroplasty technique in proximal hypospadias repair is the perceived extent of ventral curvature (VC). Cases with minimal VC today are corrected by either onlay flaps or the tubularized incised plate technique (TIP), while those with greater VC leading to transection of the urethral plate (UP) undergo 1 stage tubularized prepubic flaps or Koyanagi-type procedures, or 2 stage flap or graft repairs. I recently reported decision-making in 91 boys seen from 2000 to 2005 with midshaft to perineal hypospadias. All 35 with midshaft defects underwent TIP. Of the remaining 56 cases of proximal shaft to perineal hypospadias, TIP was used in 36 (64%) while 2 stage repairs were performed in the remaining 20 (36%) that had persistent VC greater than 30 degrees after degloving the penis and releasing ventral dartos tissues.

Straightening in these cases often included ventral dermal grafts. Choices for urethroplasty included a tubularized prepubic flap, but my general dissatisfaction with flaps led me to other considerations. While Howard Snyder will defend prepubic flaps, I continue to challenge him and others who use them to report their outcomes specifically for penoscrotal to perineal hypospadias, as the Toronto group did this year, since much of the available data comes from series of predominantly mid to distal repairs. Similarly, I did not use prepubic flaps that Aivar Bracka would champion, because I would not place a foreskin graft on a dermal corporal graft. I am philosophically unconvinced by the Koyanagi approach since the decision to transect the UP is made at the onset, while my experience showed two thirds the urethra plates can be preserved in proximal cases.

Initially I performed staged Byar’s flap repairs, with the modification of preserving the glanular UP rather than advancing skin between the glans wings. However, despite tubularizing a strip no more than 10 to 12 mm wide at the 2nd stage, diverticulum reliably developed, which I believe reflects relatively fixed resistance in the glanular urethra (without stenosis) transmitted to prepubic skin designed by nature to stretch. Furthermore, the vascular pedicle inhibits attachment of Byar’s flaps to the corpora, additionally promoting diverticulum from the inevitably turbulent urine flow through a skin-lined neourethra.

Dissatisfaction with Byar’s/TIP outcomes then led to buccal grafts to replace the UP, initially extending from the native urethra to the glans tip, and later interposed between the urethra and preserved glanular UP when problems arose with buccal grafts within the glans wings in infants. To avoid grafts on grafts, I first used buccal tissue both to fill the defect from corporotomy during straightening and for later urethroplasty, taking advantage of its relative thickness compared to other graft sources. Then I started doing multiple superficial incisions (“fairy cuts”) rather than one deep incision in the ventral corpora and placed the buccal graft over them. Urethroplasty results with all these buccal graft repairs were better, but complications remained unacceptably high at 55%.

Several lessons were learned from these cases and others I saw during this time after initial surgery by pediatric urologists elsewhere: 1. The true extent of VC cannot be accurately determined preoperatively – again, one should not enter the OR committed to transecting the UP as was once routine practice for proximal repairs 2. Ventral lengthening and straightening can be reliably achieved by fairy cuts rather than single corporal incisions requiring grafts.

3. Secure glans wing closure increases the risk for diverticulum after skin flap urethroplasties. A corollary is that a well-fused glans with a normally situated meatus seems the exception after skin flap urethroplasty, as the wings tend to separate during healing.

Mollard reported that the spongiosum and urethral plate could be dissected from the corpora to lessen VC, first in a French article and subsequently in the Journal of Urology. He found bending could be corrected in most cases of proximal shaft hypospadias, and over half those with perineal defects, by this maneuver occasionally supplemented with a dorsal plication. Urethroplasty was completed with 1 stage UP tubularization. He noted the UP became functionally longer and narrower by this dissection, but stressed it remained well-vascularized. Monfort et al used the same approach, stating dissection under the UP continued proximally for approximately 2 cm under the native urethra. Recently, Kajbafzadeh et al reported UP elevation combined with ventral corpora grafting to both straighten VC and perform TIP urethroplasty in 13 (72%) of 18 boys with penoscrotal to perineal hypospadias. The UP was transected in the remaining cases when it appeared the UP still contributed to bending as in 3 cases, or appeared “unhealthy” as in 2 cases.

Previously after transecting the UP, I would frequently next take down attachments anchoring the normal urethra to the corpora, dissecting proximally to near the urogenital diaphragm. The native urethra then could be gently stretched and re-attached to the corpora further distally, taking advantage of its elasticity to bring the proximal meatus out of the scrotum to make the 2nd stage tubularization easier and less likely to include hair-bearing skin. Consequently I was immediately receptive to Bhat’s idea to perform this same mobilization before transecting the UP.

Now I begin a proximal repair with a U-shaped incision alongside the UP to 2 mm proximal to the ectopic meatus. A midline extension is carried down the median raphe of the scrotum to give additional exposure. Ventral dartos, which often is deficient in proximal cases, is next dissected down to Buck’s fascia. In all cases the corpus spongiosum running alongside the UP is dissected from the corpora for later spongiosplasty. Then artificial erection is performed. Minor VC less than 30 degrees is corrected by a single midline dorsal plication using 6-0 polypropylene. Greater VC prompts dissection under the entire UP. Persistent curvature greater than 30 degrees then leads to mobilization of the formed urethra proximally as described above. Fairy cuts are made in the region of greatest bending, and a single dorsal plication is also done to ensure straightening (except when foreskin reconstruction is desired, in which case the dorsal shaft is not degloved and fairy cuts are made without dorsal plication). The urethra is then gently stretched distally and re-attached to the corpora. UP incision is made without dividing the plate into separate strips, and TIP is completed with a 2 layer closure, the first using subepithelial interrupted 7-0 polyglactin and the second a continuous suture using 7-0 polydioxanone. Spongiosplasty covers the neourethra from the glans proximally, and then a testicle is exposed and a tunica vaginalis flap developed for an additional barrier layer over the entire neourethra before glansplasty.

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All the authors reporting UP mobilization found it reduced or corrected VC, but maintained vascularity to the plate. The maneuver takes advantage of urethral and UP elasticity to allow the bent penis to be straightened, even with ventral lengthening, without transecting the plate. Urethroplasty can then be completed by either onlay flap or UP tubularization.

My experience comprises 12 patients in the past 2 years, 3 with UP elevation alone and the other 9 with additional urethral dissection. All underwent TIP with tunica vaginalis barrier flap. With follow-up a minimum of 3 months (mean 7 months, range 0-11) there have been no fistulas, stenoses, or recurrent VC. During the past 2 years a total of 20 patients have undergone proximal hypospadias repair, 7 by standard TIP, 12 with UP elevation and TIP, and only 1 by a 2 stage graft when the UP remained short after complete mobilization.

In reviewing this experience several points should be re-emphasized:
1. “All” midshaft hypospadias can be repaired by TIP.
2. Proximal hypospadias with VC less than 30 degrees can be repaired using TIP.
3. When VC exceeds 30 degrees after the penis is degloved and ventral dartos dissected, traditional management calls for UP transection, ventral corporal grafting, and urethroplasty by either tubularized pre-pucial flaps or staged techniques.
4. Alternatively, when VC is greater than 30 degrees, the UP can be elevated from the corpora, this dissection then continuing to release the urethra proximally. Ventral lengthening can be achieved by grafting or fairy cuts, preserving the UP for single stage urethroplasty.

Optimal management is not yet defined, but it appears transection of the UP might be avoidable today in many cases where it was previously considered routine.

References
The Koyanagi-Nonomura Technique (2 In 1 Procedure): A Valuable Alternative?

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In the treatment of primary scrotal and perineal hypospadias, among several possibilities (1 or 2-stages repair, using flap, graft or a combination of the two), our preference is for a 1-stage flap technique. We call our method “the 2-stages in 1-time procedure” (2 in 1 procedure). It represents an evolution of the original technique described in 1984 by Koyanagi et al., incorporating the major modifications later suggested by various authors, utilizing some of the principles introduced by Bracka in his two-stages graft-repair in the preparation of the new urethral plate, and resembling both the Yoke repair described by Snow and Cartwright and the first stage of Retik’s 2-stage repair. We would like to underline that we never applied the 2 in 1 procedure in redo proximal hypospadias repair, as, in our opinion, that should always be treated with the Bracka’s 2-stage graft procedure. We also emphasize that, in our practice, in the great majority of high scrotal and penoscrotal hypospadias, regardless the presence of penile curvature and partial penoscrotal transposition, the original urethral plate can be used and, therefore, they should be repaired following the classical Snodgrass principle of urethral plate augmentation with a midline incision. According to this strict case selection, we utilized the 2 in 1 procedure only in the most severe forms of hypospadias (mid-scrotal and perineal), which occur in about 1 every 30 cases of hypospadias treated in our institutions (Fig. 1A).

2 in 1 Technique

The patient is positioned in a gentle lithotomy position. A sagittally oriented stay suture in the dorsal aspect of the glans and 2 extra stay sutures in the prepuce allow marking the Koyanagi-Nonomura flap, which is not dissected at this stage (Fig. 1B,C). A circumferential incision is started dorsally and completed anteriorly, severing the urethral plate (Fig. 2A). Ventrally, the dissection is deepened to remove the atretic urethral plate and corpus spongiosum (Fig. 2B); laterally all fibrous bands contributing to penile curvature are removed. Frequently, the dissection is extended proximally to the urethral meatus, between the corpus spongiosum that surrounds the urethra and corpora cavernosa. The urethra is, therefore, detached from the corpora for the needed length and mobilized in a proximal direction. When all the fibrous bands are detached, residual intrinsic curvature of the corpora cavernosa is tested with an artificial erection, injecting saline inside the corpora (Fig. 2C). Residual curvature, if present, is treated according to the preferred technique (Fig. 2D). Keeping the penis on traction with the glandular stay suture, a transverse incision is carried out dorsally on the penile skin considerably below the prepuce, leaving proximally an adequate amount of penile skin to create a skin cylinder to cover the penis at the end of the procedure (Fig. 3A-C). The incision is deepened through the skin, while the dartos layer is carefully separated in the midline, paying attention not to damage the longitudinally running blood vessels. The inner portion of the foreskin is left untouched. The incision is kept to the minimal length sufficient to allow the passage of the glans through the buttonhole (Fig. 3D). The entire foreskin and part of the dorsal penile skin are transposed ventrally (Fig. 4A). Dorsal and ventral foreskin are incised in the midline and the two layers are carefully unfurled, leaving inner foreskin medially and outer (continued on next page)
The idea of combining the advantages of a single stage repair with the safety of a staged reconstruction led us to develop the 2 in 1 Procedure. The procedure stems from the Koyanagi-Nonomura one-stage repair, its additional refinements, and its further modifications, with the main purpose to optimize the vascularity of the flaps and the penile skin. In the 2 in 1 Procedure, after straightening of the shaft, the prepuce and some dorsal penile skin are brought anteriorly creating a new urethral plate. The new urethral plate is secured to the corpora on their ventral aspect and inside the divided glans penis.

In comparison with other one-stage techniques, the 2 in 1 Procedure seems to be easier and less time consuming. It allows the simultaneous treatment of penile curvature and penoscrotal transposition and it is not influenced by the amount of available preputial skin. Rate and range of complications are acceptable, considering the fact that only the most severe and challenging hypospadias are currently treated with the herein presented method. Postoperative management is quite simple and similar to that of post-op of simple hypospadias repair with urine is drained with a stent dripping between two nappies, allowing early discharge from the hospital.

In conclusion, we believe that the 2 in 1 Procedure is a safe alternative that allows treating most severe primary hypospadias forms with only one operation performed at young age and with the perspective of obtaining satisfactory functional, anatomical and aesthetic results.

**Bibliography**

The Three-In-One Technique for One-Stage Complex Hypospadias Repair

Hypospadias repair is regarded as a challenging operation and complex primary forms can be treated according to different strategies. Some of my reconstructive ancestors have presented their opinions and arguments for a two-step strategy. Most of their arguments are logical, but in my opinion our decisions should also take into account parent’s concerns and the desire for correction with a single operation, especially when the surgeon feels comfortable enough to adopt both concepts and have comparable results in either a one or two-step technique. It is unquestionable that treating the patient in one step will require a surgeon with expertise in reconstructive surgery with skills in flap and graft handling. On the other hand, any pediatric urologist that deals with proximal hypospadias needs this background anyway. “The three-in-one technique” is simply the incorporation of well known steps of hypospadias repair at the same time: 1. Incision of the urethral plate for straightening the penis. 2. Dorsal grafting in the corpora cavernosa replacing the defect created by the incision in order to reconstruct the urethral plate. 3. Internal preputial flap for onlay urethroplasty. 4. Second flap of tunica vaginalis and cremaster to cover the neourethra and avoid a fistula.

In 2004, we described this new approach of one-stage urethroplasty using a free buccal mucosa graft to lengthen the urethral plate, allowing for complete resection of chordee with no residual curvature. This method produces a safe reconstruction in only one surgical stage and is in accordance with the present tendency of onlay reconstruction of the urethra. As all of us are aware, dorsal buccal mucosa graft in urethroplasty is a safe method and has been popularized in adults by Barbagli and in hypospadias cripples and severe hypospadias forms by Bracka. Buccal mucosa is a versatile alternative of donor site and proved to have good integration to the adjacent urethra in an experimental model in rabbits.

Technique

After section of the urethral plate to correct ventral curvature, the original plate is anchored to the proximal penile shaft by 6-0 PDS sutures (Fig 1). The glans is further sectioned in the midline to produce two wide glandular wings and allow dorsal placement of the buccal mucosa graft also in the glandular area up to the desired neo-meatus.

The distance between the incomplete urethral plate and the glans is then measured to define the necessary length of the buccal mucosa graft, taking into account 20% shrinkage of the harvest graft.

Buccal mucosa is harvested from the lower lip, with extension to the inside aspect of the cheek when a longer graft is necessary. The harvest site is left open and the graft prepared by removal of submucosal fatty tissue. The graft is then sutured to the ventral penile shaft area by interrupted 6-0 PDS sutures to restore the defect of the urethral plate and to prepare the foundations of the neourethra (Fig 2-6). The mucosal layer of the buccal mucosa faces the future neourethra. A transverse preputial flap is obtained and anastomosed “onlay” to the reconstructed neourethra with running 6-0 PDS sutures with care to anchor the sutures of the buccal mucosa “track” also to the Buck’s fascia to stabilize the anastomosis. The scrotal fascia is opened in the site opposite the placement of the pedicle of the preputial flap and a careful dissection of the tunica vaginalis and cremasteric tissue was performed isolating it from testicular cord structures. This second flap is used to cover the neourethra and fixed to the corpora by angular interrupted 6-0 PDS sutures (Fig 3). The penile skin is reconstructed and in cases of lack of ventral skin with associated penoscrotal transposition, two additional scrotal skin flaps are produced and mobilized ventrally to achieve a better cosmetic appearance of both the penis shaft and the scrotum (Fig 4). We can see the different steps of the description of the technique in one patient and the final aspect after two months (Fig 5, 6, 7, 8).

In all cases a 6 Fr silicone tube is left within the urethra for 7 to 10 days and a cystostomy tube for 2 to 3 weeks. Initial dressings were left untouched for at least 3 days postoperatively.

Clinical Data

From March 2002 to December 2005, a total of 22 patients underwent one-stage primary complex hypospadias repair using the three-in-one technique. We performed 9 scrotal, 8 penoscrotal and 4 perineal repairs. Our series consisted of children less than 6 years of age, except for one adult (28 years) with a complex perineal hypospadias that had been brought up as a female in the countryside of Brazil before he was referred to our institution.

Mean age at surgery was 2.4 years, (1 to 6) in 21 patients (excluding the adult patient). Complications included 3 cases of urethral diverticula, 3 uncomplicated fistulas, 2 meatal stenosis and one patient developed excessive ventral skin retraction. The overall complication rate was 40.9%. One fistula closed spontaneously, whereas the other two required surgical revision and were corrected in an outpatient regimen.

The most complex complication in this series was a urethral diverticula that required open reconstruction. Two patients underwent outpatient meatotomy and one other had open surgical release of the ventral scarred tissue. The redo rate in the series was 36.3%. No complications related to the harvest site were seen.

Clinical complications without major consequences to the patients were found in 4 patients consisting of 2 UTI and 2 epididymo-orchitis. Mean follow-up for this first series is 4.2 years (2.5 to 6).

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The goals of hypospadias surgery remain the creation of a straight, cosmetically acceptable phallus consisting of an orthotopic slit-like urethral meatus and conically shaped glans and adequate skin coverage with an appropriate mucosal collar. Proximal hypospadias remains a challenging and controversial aspect of pediatric urology. Unlike distal and mid shaft repairs, numerous techniques are reported for proximal hypospadias, which translates to the fact that no single repair has clearly demonstrated superiority with respect to complication rate, cosmesis and long-term outcome. Proximal hypospadias with chordee is the most challenging variant of hypospadias to reconstruct. Surgical techniques have been described that may be broadly classified as 1, 2 or multiple stage procedures.

To repair proximal severe hypospadias Duckett reported the use of a transverse tubularized island flap made of inner preputial skin to fashion a neourethra. However, contrary to Duckett’s initial results, somewhat high complication rates have been reported and this technique has been largely abandoned because of their prohibitive long-term complication rate. To achieve better results, the onlay island flap technique with preservation of the urethral plate has become the most common approach for severe hypospadias.

At present, in the majority of posterior hypospadias, including perineal hypospadias, the urethral plate can be preserved and a vascularized flap used in an onlay fashion. In the rare case when the urethral plate needs to be resected, a 2-stage technique can be used.

We agree that most hypospadias repairs should be done without transecting the urethral plate. Nevertheless, we know that in some patients with severely curved hypospadias we cannot achieve adequate penile straightening without resecting the plate. While a 2-stage approach to these difficult cases has been advocated, we have used a new repair technique as a one-stage procedure named the “three-in-one” technique.

With advances in suture materials, use of optical magnification and microsurgical instrumentation, hypospadias repair in one stage has developed into a safe and reliable procedure, with very high reported success rates. We think that lengthening the urethral plate with a buccal mucosa graft is an optimal procedure in cases of severe chordee. Our complication rate of about 40% is acceptable, especially if we consider that 60% of our patients were successfully treated in one single surgery. Recent studies of outcomes following 2-stage repairs report reoperation rates of 5% to 41% after the planned stage 2 repair.

Our results with the “three-in-one” technique have had a trial that was long enough to support the feasibility of this type of surgery. Besides the desirability of completing the reconstruction in one operation, a one-stage operation has the additional advantage of using skin that is unscarred from previous surgical procedures, the normal blood supply of which has not been disrupted.

Furthermore the approach has been adapted from the Barbagli’s well-established technique for urethral stricture, and we previously investigated the healing of dorsal buccal mucosa grafts in an experimental model in rabbits showing that the graft keeps its histological properties fully integrated to the urethral epithelium. Recently we have been interested in evaluating the tunica vaginalis as an optional graft to reconstruct the urethral plate and both experimental and initial clinical data are promising.

In conclusion, we believe that there is also a psychological benefit to the family and, ultimately, to the boy to enable him to appear as normal as possible at the first stage, as this technique does, and to leave the second stage for minor skin moving and correction of any complications from urethroplasty. We agree that considerable expertise in hypospadias surgery might be required to perform this technique whereas a two-stage procedure is much more straight-forward. One should bear in mind that such complex hypospadias forms are naturally referred to “hypospadiologists” and “three-in-one” technique offers a reliable one-stage repair, being our procedure of choice for most difficult cases of severe hypospadias.

References

The Tunica Vaginalis: A Versatile Dorsal Graft for Urethroplasty
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Defects in the male urethra caused by congenital malformations or traumatic injuries have created a need for tissues that can serve as adequate urethral substitutes. Various donor tissues have been used clinically for urethral repair, including vascularized skin flaps from the prepuce, scrotum or penile shaft, full thickness free skin grafts, vesical or buccal mucosa grafts, and tunica vaginalis, ureter, artery, vein and appendix tissue. Actually, vascularized skin flaps are the preferred material for use in urethral reconstructions when available, mainly for primary urethral repairs. However, many problems still remain with the current methods, making it a field of further exploration for reconstructive urologists.

The goals of primary hypospadias repair include straightening the curvature of the penis, extending the meatus to the glans tip, and revising the abnormal prepuce by either circumcision or foreskin reconstruction to allow satisfactory urination and sexual function. Correction of penile chordee is the initial step in the management of hypospadias. In most instances releasing the tight ventral skin is sufficient for correcting mild penile chordee. In these cases, when the urethral plate does not require transection, a one-stage repair is used. Actually, for anterior hypospadias the most commonly accepted procedures are the meatal advancement glansplasty (MAGPI), the glans approximation procedure (GAP), the Mathieu or flip-flap, and the Snodgrass modification of incised plate urethroplasty.

For the treatment of posterior hypospadias the benefits of urethral plate preservation and advantages of onlays over tubes are well known, and at present, in the majority of posterior hypospadias, the urethral plate can be preserved and a vascularized flap used in an onlay fashion or a Snodgrass modification with tubularization. However, in the presence of severe proximal forms, with significant chordee, urethral plate transection becomes inevitable, and a full circumferential substitution urethroplasty is then required.

Single stage tubularized repairs, the most popular being the Duckett tubularized preputial island flap, have been largely abandoned because of their prohibitive long-term complication rate. Nevertheless, in some of these cases the prepuce may be inadequate for urethroplasty or altogether absent following circumcision. Similarly in reoperative cases there may be significant scarring of the tissues, so that substitution urethroplasty is needed, and skin may not be available, justifying the consideration of replacement urethroplasty.

The advent of buccal mucosa as a urethral substitution material has revolutionized the management of these challenging cases. Unlike bladder mucosa, which is an obligatory wet mucosa that, therefore, has to be used as a one-stage tube and kept away from the meatus, buccal mucosa is a robust material that can be left exposed to the air for long periods. For this reason it can be used for two-stage urethroplasty in much the same way as a full-thickness skin graft.

For a subset of patients with scrotal or perineal hypospadias, a small phallus and severe chordee, a two-stage repair such as described by Bracka is regarded by many as a better option. In the first stage, the penis is straightened and the scarred urethra is discarded. Buccal mucosa is harvested from either the check or lip and grafted to the prepared bed. The second stage urethroplasty is undertaken at least 6 months after the first stage. These patients, if treated with one-stage repair, usually need a composite graft. Some centers reported unsatisfactory experience with the operative results in such patients managed with one-stage repair.

Recently our group described an original one-stage approach to treating primary complex hypospadias using buccal mucosa to reconstruct the urethral plate in such patients when preservation of the urethral plate is not possible. Despite these advances in urethroplasty technique, certain proximal and reoperative cases remain a problem for the modern hypospadias surgeon. Complications occur even in the best hands. Thus, creative additions to current techniques are still needed.

The search for an ideal urethral substitute carries on as investigators continue to evaluate various materials for substitution urethroplasty. In 1986 Snow used tunica vaginalis as a wrap around the neourethra during hypospadias repair. Apart from a blanket wrap experience with tunica vaginalis in hypospadias surgery has been limited. Snow and Cartwright tubularized tunica vaginalis in 3 reoperative cases and observed meatal stenosis in all. Meatal stenosis occurred in 3 of 5 patients and urethral stricture developed in 3 of 5 in the experience of Joseph and Perez with tunica vaginalis onlay flaps. No fistula occurred. Khoury et al used a vascularized tube flap of tunica vaginalis to replace the penile urethra in 12 rabbits. Two of the 10 flaps that were available for assessment became necrotic due to compression of the vascular pedicle and anastomotic stricture developed in 1 rabbit. The healing process was satisfactory clinically and histologically in the remaining 7 flaps. Theodosescou et al studied 26 rabbits with an onlay or a tube flap. All 16 rabbits in the onlay group had excellent flap viability and a 100% urethral patency rate. The mesothelial lining of the tunica was replaced by a stratified epithelial lining similar to native urethra. All 8 rabbits with tube flaps died of urinary retention. They showed neourethral contracture, probably secondary to striated cremasteric muscle elements brought with the tunica during mobilization. The lumen of the tube was completely collapsed as a result of contraction of the cremasteric muscle, which was part of the flap. No evidence of ischemia was found and vessels to the flap were patent on microscopy.

These studies influenced us to explore the use of tunica vaginalis as an alternative material for urethral reconstruction. Using an animal model we evaluated a tunica vaginalis graft as a substitute for buccal mucosa in dorsal urethroplasty. All animals demonstrated a patent and functional urethra, as evidenced by radiographic and histological analyses (Figure 1). The explanation of our good results is probably that dorsal placement of the graft enhanced graft immobilization and the direct blood supply from the corpora perforating the vessels was probably responsible for good graft incorporation.

Based on our in vivo (experimental) experience with tunica vaginalis graft urethroplasty, a pilot clinical study is being performed in our university clinical hospital to evaluate the safety and efficacy of this new technique to correct severe urethral strictures. Recently we published our short-term experience with tunica vaginalis grafts, placed dorsally, for the treatment of anterior urethral strictures. Preliminary results on 11 patients demonstrate that in our initial experience all patients had anatomically and functionally patent urethras as demonstrated by retrograde urethrography and uroflowmetry. The most important limitation of this study is the length of followup.
Our experience, although on a small number of patients, is an essential step to evaluation of the role of tunica vaginalis urethroplasty. The initial results show that tunica vaginalis is a very good substitute on which natural urothelium grows. In terms of the registered complications the results are very promising.

Regarding the place of tunica vaginalis in the algorithm for hypospadias repair, we recommend this technique in circumcised patients with primary proximal hypospadias and severe chordee requiring transection of the urethral plate when there is no adequate genital skin. We emphasize that this technique is reserved for especially difficult circumstances.

More clinical work must be done before most urologists will be fully comfortable with using tunica vaginalis urethroplasty. However, no hesitation should exist in performing more urethroplasty procedures with tunica vaginalis as the grafting material. Long-term outcomes and multicenter experiences with this approach are definitely needed to confirm the good short-term results.

Fig. 1 - A 4 cm. urethral stricture treated by dorsal tunica vaginalis graft urethroplasty.

References
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GUEST EDITOR: ANTONIO MACEDO, JR., M.D.

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