Hypospadias

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Table of Contents

Preface ............................................................... ii
Introduction ...................................................... 1
Penile Anatomy .................................................. 1
Classification .................................................... 2
Epidemiology ..................................................... 2
Embryology ....................................................... 3
Diagnosis .......................................................... 3
Preoperative Considerations ................................. 4
Essential Surgical Armamentarium ....................... 6
Surgical Techniques ............................................ 7
Postoperative Considerations ............................... 20
Board Review Questions ..................................... 24
Answers .......................................................... 26
Explanation of Answers ...................................... 26
References ....................................................... 27

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Preface

Physician certification and recertification are increasingly required by managed care organizations and hospitals. Certification by the American Board of Urology encompasses a qualifying examination and a subsequent certifying examination. Admission to the qualifying examination requires that the applicant complete an approved urology residency program. Admission to the certifying examination requires that the candidate pass the qualifying examination, have 18 months of clinical urology experience, and submit a surgical log. Every 10 years, certified urologists must complete the recertification process, which includes a separate examination.

The *Hospital Physician Urology Board Review Manual* is a study guide intended to help candidates prepare for these examinations. The manual focuses on the key content areas of the examinations, including:

- Adrenal glands
- Calculus disease
- Female urology
- Infections and inflammations
- Infertility
- Neoplasms
- Neurogenic bladder
- Obstructive uropathy
- Pediatric urology
- Physiology
- Renal transplantation
- Renovascular hypertension
- Sexual dysfunction
- Sexually transmitted diseases
- Surgery
- Trauma and fistulae
- Urinary diversion and reconstruction

Urology is a surgical subspecialty, but this discipline requires knowledge of select areas of internal medicine, pediatrics, and gynecology. The adrenal glands, kidneys, ureters, bladder, and male sexual organs, which are affected by the body’s homeostasis, also affect other organ systems.

Board examination candidates and Board-certified urologists will find the *Hospital Physician Urology Board Review Manual* to be an excellent resource. The manual reviews the essential, well-recognized principles and theories of urologic disorders as well as current concepts and developments in clinical urology and basic science underlying the discipline. The manual highlights urologic information compiled from journal articles, monographs, and textbooks. The manual’s outline format presents information in an efficient, concise manner. The outline headings and subheadings serve as a checklist of topics for examination candidates to study and review. Urologists are encouraged to read the manual in sections and use it to prompt further study.

The outlined text is complemented by tables, diagrams, and questions for self-assessment. The tables and diagrams throughout the manual were selected for their clarity, educational value, and ability to illustrate, highlight, or summarize essential facts and concepts that the candidate must know to successfully complete the Board examination. For the purpose of self-assessment, the manual includes multiple choice and case-based questions that reflect the Board examination’s format and topics. The questions allow users to test their understanding of the main concepts of urology.

This manual was developed without involvement of or review by the American Board of Urology. The manual is based on the Editor’s and Contributors’ familiarity with basic science information and urologic data, clinical experience, and an awareness of new developments and research results. An academically competent urologist must also bring compassion, responsibility, and integrity to the bedside and operating room.

I am hopeful that this manual will serve you well in your preparation for the examinations and as a periodic review of urology. Good luck in your studies.

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I. INTRODUCTION

A. Definition of hypospadias. In male infants born with hypospadias, the urethral opening is misplaced on the ventral penile shaft proximal to the glans tip.

B. Treatment. Management of hypospadias involves surgical repair. Hormones may be given on a supplementary basis. Objectives of repair include:
   1. Completely relieving chordee, permitting a straight erection (orthoplasty)
   2. Repositioning the meatus to the tip of the glans
   3. Forming a uniform caliber urethra free of fistulas, strictures, or hair
   4. Creating a symmetric glans and penile shaft
   5. Allowing the patient to have a solid, straight urinary stream

II. PENILE ANATOMY

A. Review of normal anatomy
   1. External anatomy
      a. The glans is typically conical in shape with the meatus located at its distal tip.
      b. The penile shaft is cylindrical with highly elastic skin that is devoid of hair or glandular elements with the exception of the smegma-producing glands at the coronal base.
   2. Penile cross-sectional anatomy is shown in Figure 1.

B. Abnormal anatomic features of patients with hypospadias
   1. The meatus is dystopic.
   2. The investing layers of the urethra proximal to the meatal opening may exhibit a spectrum of deficiencies.
The skin, dartos fascia, Buck’s fascia, and corpus spongiosum may be poorly developed, or in some cases, almost completely absent proximal to the visualized meatal opening.

It is recommended that the surgeon correctly identify the area along the ventral urethra where these layers appear normal and initiate the hypospadias repair from this point to optimize the chance of a successful repair.

Instead of the typical V-shaped configuration of the urethral plate, a transverse meatal tissue web often is present, resulting in deflection of the urinary stream.

The conical glans ranges from ventrally flattened to normal appearing.

Typically, the ventral preputial segment is deficiently formed in patients with hypospadias. An exception is the megameatus intact prepuce variant in 2% to 3% of patients.

Chordee of varying degrees may be present.

### III. CLASSIFICATION

A. Hypospadias may be classified according to the location of the meatal opening (Figure 2). The surgeon should specify whether this description is prior to or following the correction of any associated chordee.

B. Barcat suggests that classification be defined according to the new location of the meatus after the correction of any associated chordee.

### IV. EPIDEMIOLOGY

A. Incidence. Hypospadias occurs in 1 in 300 live male births.\(^3\)

B. Familial tendencies and genetic factors

1. Sorber and colleagues found a 9.4% familial incidence of hypospadias.
2. Bauer and colleagues reported that 14% of male siblings were affected.

C. Associated anomalies\(^4,6\)

1. Cryptorchidism (8.6%)
2. Renal abnormalities (1.8%)
3. Urethral valves (0.4%)

D. Prevalence is higher in Caucasians than in African Americans.

E. Environmental factors. Estrogens and progestins used during pregnancy have been associated with an increased incidence of hypospadias.\(^7\) The specific etiology remains unknown but may be secondary to a disruption of the male sex hormone axis. Additional research is ongoing and should provide a better understanding of the multifactorial etiology of hypospadias.
V. EMBRYOLOGY

A. Review of normal embryology
   1. There is asynchronous development of the external genitalia and upper urinary tract.
   2. Sexual differentiation begins at approximately 8 weeks gestational age.
   3. At 15 weeks gestational age, urethral development usually is complete.
   4. The urethral development is under the influence of testosterone.

B. In patients with hypospadias, embryologic development of the male urethra is incomplete.
   1. Interruption of the elongation of the urethral groove or failure of the urethral folds to coalesce in the midline results in subcoronal hypospadias.
   2. The distal glans channel canalizes under hormonal influence to form a urethral meatus at the glans apex.
   3. The mesenchyme that forms the structures normally surrounding the urethra also ceases to develop, causing malformation of several structures, including:
      a. Corpus spongiosum
      b. Buck's fascia
      c. Dartos fascia
      d. Skin, which may be thinned and lacking substantial vascular support
      e. Ventral tunica albuginea of the corpora cavernosa
   4. Chordee may result from embryologic malformations (Figure 3), such as:
      a. Skin or tethered fascial layers shortening the ventral aspect of the penis
      b. Dysgenesis of the corpus spongiosum
      c. Differential compliance between the ventral and dorsal tunica albuginea of the corpora cavernosa (corporeal disproportion)
   5. The embryologic basis of chordee is poorly understood.
      a. Typically, the more proximal the meatal opening, the greater the severity of chordee.
      b. Kaplan and Brock proposed that chordee is the result of a growth differential between the normally formed dorsal tissue of the corporeal bodies and the deficient ventral tissue and urethra.

VI. DIAGNOSIS

A. Diagnosis usually made at birth. In the vast majority of cases, the diagnosis of hypospadias is made at birth. Occasionally, hypospadias is recognized later; most of these cases are the megameatus intact prepuce variant.

B. Intersex must be ruled out in patients with the more severe forms of hypospadias, especially in those with associated cryptorchidism. The differential diagnosis includes:
   1. Adrenogenital syndrome
   2. Mixed gonadal dysgenesis
   3. Reifenstein syndrome (incomplete male pseudohermaphroditism type I)
   4. 5α-Reductase deficiency (incomplete male pseudohermaphroditism type II)
   5. True hermaphroditism

C. Parental issues. The diagnosis should be discussed with the parents and all questions should be
answered. Parental guilt and anxiety may accompany the diagnosis; reassurance is frequently necessary.

VII. PREOPERATIVE CONSIDERATIONS

A. Preoperative evaluation. The surgeon should meet with the patient and parents/guardians preoperatively in the office. It is critical to provide parents/guardians with adequate information on the procedures and their potential complications.

1. A thorough history and physical examination should be performed. The location of the meatal opening, severity of chordee, quality of the penile skin, and overall penile size should be evaluated. Details of prior genital surgeries should be noted. Bleeding tendencies should be documented.

2. Evaluation for associated anomalies should be considered.
   a. Cryptorchidism and inguinal hernias are the most common associated anomalies.
      1) Khuri and associates\(^\text{10}\) reported a 9% incidence of both cryptorchidism and inguinal hernias in patients with hypospadias.
      2) The incidence of cryptorchidism is directly related to the severity of the hypospadias. In the Khuri and colleagues\(^\text{10}\) series, cryptorchidism occurred in just 5% of patients with distal hypospadias but in more than 30% of patients with proximal variants.
      3) Cryptorchidism in conjunction with hypospadias should raise the question of intersex and prompt a karyotype investigation.
   b. Penile torsion is seen in approximately 15% of patients.\(^\text{11}\) It usually is accompanied by an eccentric raphe, and the course of the urethra may follow the route of the raphe.
   c. Enlarged utricle is similar to undescended testis; the incidence is directly related to the severity of hypospadias. Shima and colleagues\(^\text{12}\) found enlarged utricles in 30% of patients with scrotal-perineal variants compared to only 3% in those with glanular hypospadias. An enlarged utricle rarely is of clinical significance, and routine excision is not indicated.
   d. Penoscrotal transposition occurs when the penile shaft emanates from the pubic region inferior to the scrotum. On physical examination the scrotum appears to “drape” over the base of the penile shaft.
   e. Other urinary anomalies
      1) Isolated hypospadias, regardless of severity, has not been shown to be associated with an increased incidence of clinically significant upper urinary tract anomalies.\(^\text{13}\)
      2) When associated with other systemic anomalies (ie, chromosomal anomalies), however, hypospadias carries an increased incidence of upper urinary tract anomalies on the order of 12% to 15%.\(^\text{9,13}\)
3) Screening of the upper urinary tract is not indicated in those with hypospadias alone with or without undescended testes or inguinal hernia.6

3. Laboratory testing. If the history or physical examination suggests the need for any laboratory tests, these should be added to the preoperative evaluation (eg, karyotyping in cases of suspected mixed gonadal dysgenesis or true hermaphroditism; measurement of urinary 17-ketosteroid excretion and plasma dehydroepiandrosterone [DHEA] sulfate in cases of suspected 21-hydroxylase deficiency).

B. Optimal timing of surgical repair.14–16 Ideally, hypospadias repair should be done when the child is between 6 and 24 months of age. This age range is ideal for several reasons.
1. There is no added perioperative anesthetic risk to the child after 6 months of age.
2. At 6 months of age, the penis usually is sufficient in size to allow successful operative repair.
3. Sexual orientation and parental bonding are least affected at this early age, and psychological damage to the child is minimized.
4. Postoperative management is easier when the child is in diapers.

C. Selecting the surgical approach.17 Historically, more than 200 urethroplasties and their modifications have been described to correct hypospadias. No single technique is universally applicable; surgical flexibility and ability are essential. The most important factor in optimizing the surgical outcome is to select a technique that is most ideally and specifically suited to the patient’s anatomy.
1. Examining the tissues. The patient’s tissues, including the shaft, glans, and urethral plate, should be assessed. The degree of chordee also should be assessed, and the meatal position upon chordee release should be anticipated.
2. Reviewing the options. The repair options should be reviewed, and their respective functional and cosmetic success rates should be considered. A 1-stage procedure is preferred; however, a staged repair is appropriate if the surgeon feels that the outcome will be better. Options include:
   a. Meatal advancement and glanuloplasty (MAGPI)
   b. Perimetal flap (Mathieu, “flip-flap”) procedure
   c. Perimetal tube (Mustarde) procedure
   d. Onlay and tubed preputial flap procedures
   e. Tubularized incised-plate urethroplasty (Thiersch-Duplay technique)
   f. Tube graft using skin, bladder mucosa, or buccal mucosa

3. Outpatient versus inpatient repair
   a. Uncomplicated hypospadias repairs frequently are accomplished in an outpatient setting.
   b. Complex hypospadias repairs (ie, extensive dissection, free grafts, redo operations in cases of failed initial hypospadias repair) and repairs requiring more advanced support systems are best managed with inpatient postoperative monitoring.

D. Preoperative hormonal supplementation (with gonadotropin or testosterone) has been suggested to increase penile tissue vascularity and provide better quality tissue for repair in a small body of literature.18,19 Hormonal supplementation alone has not been shown to correct hypospadias and has been used only as an adjuvant to surgical correction.
1. Gonadotropin initiates testicular androgen production and enhances penile growth and tissue vascularity.
2. Exogenous testosterone is useful when testicular response to gonadotropin is inadequate. A 5% testosterone cream can be rubbed on the genitals daily for 3 weeks. Intramuscular testosterone propionate (2 mg/kg) can be administered 5 weeks and 2 weeks prior to surgery as an adjunct to repair. Testosterone has been shown to increase penile length and circumference as well as local vascularity.

3. Side effects. Potential side effects, including increased bone age and excessive pubic hair, have not been reported to be a problem with gonadotropin or testosterone supplementation in genital reconstructive surgery.

E. Preparation for surgery
1. Preparing the operating room
   a. Communication among the nurses, anesthesiologists, surgeons, and patient’s family is paramount throughout the perioperative period. It is essential that the
surgeon inform the operating room staff preoperatively of any special requests (eg, the need for special catheters, suture materials, or instruments; the need to prepare the operating room for a patient with a latex allergy).

b. The surgeon should assess the preparation of the room before the child is brought in for the procedure to ensure that all equipment necessary for a successful repair is available (see VII. D. 2.).

c. The nurses should be familiar with the particular instrument and suture needs of the surgeon (usually expressed on the surgeon’s operating room card for a particular procedure).

2. **Tissue handling and proper instrumentation.**
The surgeon must be well versed in plastic surgical principles and techniques, such as the creation and rotation of tissue flaps. A layered tissue closure is advantageous, and suture lines should be inverted whenever possible. Urinary diversion allows stenting of the repair.

a. **Proper instruments** include:
   1) Castroviejo needle holders
   2) Bishop-Harmon forceps
   3) Fine iris scissors
   4) Skin hooks
   5) Optical magnification

b. **Tissue handling**
   1) Direct tissue trauma should be minimized.
   2) Skin hooks or fine traction sutures should be used.

c. **Fine suture material**
   1) Fine chromic sutures are rapidly absorbed and typically used for skin.
   2) Polyglycolic or polydioxanone suture material is minimally reactive and tends to work well for the urethral reconstruction.

3. **Anesthetic considerations**

   a. **Preparing the patient**
      1) Premedication
      2) Warming lights for patient
      3) Monitoring
         a) Oxygen saturation monitoring
         b) Precordial or esophageal stethoscope
         c) Blood pressure monitoring
         d) Temperature probes

   b. **Regional anesthetic blocks for postoperative comfort**
      1) Penile block (**Figure 4**). The dorsal penile nerve block with 0.25% bupivacaine hydrochloride is an effective adjunct. It provides good postoperative pain relief and reduces the need for intraoperative anesthesia. The procedure is as follows.
         a) Palpate the symphysis pubis.
         b) Insert a 25-gauge needle just to one side of the midline and caudal to the bone.
         c) Pop beneath Buck’s fascia with the needle tip.
         d) Aspirate and then inject analgesia.
         e) Repeat the technique on the contralateral side of the midline.

   2) Caudal block
      a) A needle is used to penetrate the sacrococcygeal membrane.
      b) When the proper space is entered there is a characteristic loss of resistance to air.
      c) Single dose or continuous caudal epidural infusion may be used as an adjunct to general anesthesia.

4. **Prophylactic antibiotics** generally are thought to be nonessential. They may be of benefit when using free grafts or performing redo procedures. Antibiotic suppression is recommended when indwelling catheters are used postoperatively.

VIII. **ESSENTIAL SURGICAL ARMAMENTARIUM**

A. **Hemostasis**
   1. Epinephrine-soaked sponges promote vasoconstriction.
   2. Subcutaneous or intraglanular epinephrine (1:100,000) in lidocaine (1%; maximum dosage 5 mg/kg) is a useful adjunct.
   3. Elastic tourniquets should be used but should be released every 20 minutes to prevent prolonged devascularization.
4. Low-current cautery can be used to seal a bleeding vessel.
5. Pressure dressings will control most minor bleeding.
6. Infrequently, a small Penrose drain or Hemovac suction is necessary subcutaneously.

B. Artificial erection
1. Reported first by Gittes and McLaughlin,\textsuperscript{21} the technique has made an invaluable contribution to the success of orthoplasty.
2. Normal saline is injected either through the glans or on the side of the shaft into the corporeal bodies with a proximal tourniquet in place to define the extent of chordee and to ensure complete correction.

C. Tunica albuginea plication\textsuperscript{22,23} (Figure 5) is effective for the correction of corporeal disproportion after complete excision of all fibrous chordee. The surgical technique is as follows.
1. Buck’s fascia is elevated at the 10- and 2-o’clock positions.
2. The neurovascular bundles are identified and lifted away from the tunica albuginea.
3. Parallel incisions are made through the tunica albuginea.
4. Permanent sutures (ie, polypropylene) are used to approximate the outer edges of the tunica albuginea incisions.
5. Artificial erection is used to confirm successful orthoplasty.

D. Tunica vaginalis blanket wrap (Figure 6) involves interposition of a tunica vaginalis flap mobilized on its own vascular pedicle to cover hypospadias repair. Snow and colleagues\textsuperscript{24} reported decreased fistula rates with this technique.

E. Byars flaps
1. The dorsal preputial tissue is split vertically to the level of the coronal sulcus.
2. Bipedicled preputial skin is mobilized to the ventral shaft.
3. Skin closure is accomplished using a Z-plasty technique.

F. Scrotoplasty (Figure 7) is indicated in cases of penoscrotal transposition. It usually is performed as a second-stage procedure following successful orthoplasty and urethral reconstruction.

G. Laser tissue welding was first proposed by Kirsh and associates\textsuperscript{25,26} for urethroplasty. The technique employs laser energy from a diode laser at a wavelength of 808 nm. The protein solder is composed of 37.5% albumin mixed with indocyanine green. Clinical trials have been promising.

IX. SURGICAL TECHNIQUES

A. MAGPI\textsuperscript{6,19,22} repair is ideal for correction of distal hypospadias with little or no associated chordee. The meatus should be within 1 cm of the glans tip if the MAGPI repair is contemplated. It is essential that the perimeatal skin is of good quality and mobility; the procedure cannot be performed if the meatus is noncompliant.
1. Surgical technique (Figure 8)
   a. Ventral urethral mobility must be tested using tissue forceps and applying distal traction on the meatus before committing to this repair.
   b. A circumferential incision is made proximal to the meatus and coronal border.
   c. The shaft skin is degloved to the base of the penis, with close attention to the underlying urethra.
   d. Any corporeal attachments causing tethering are released.
   e. The dorsal margin of the meatus is incised vertically extending to the distal
most aspect of the glans groove. Alternatively, a wedge of tissue may be excised from the dorsal margin of the meatus.

f. A Heineke-Mikulicz transverse closure of the dorsal margin of the meatus advances the dorsal wall of the urethra to the apex of the glanular groove.

g. The proximal edge of the meatus is elevated toward the glans tip using a traction suture or skin hook.

h. Any excess tissue on the medial aspects of the glans wings is excised sharply.

i. The deep glans tissue is approximated, followed by the epithelial layer of the glans with separate absorbable suture layers in the midline. This maneuver both advances and supports the meatus.

j. Excess preputial skin is removed, and the skin edges are closed using fine chronic sutures. Byars flaps may be used in patients who have insufficient ventral skin.

k. The Pyramid procedure (Figure 9) has been described to repair the megameatus intact prepuce variant in circumcised patients.

1) Periurethral dissection to the apex of an imaginary inverted pyramid is performed.

2) Excising a wedge of tissue reduces the caliber of the ventral urethra.

3) The neourethra and glans are closed.

2. Postoperative complications

a. Meatal regression is the most common postoperative complication and usually is secondary to tension on the suture lines. To correct the retrusive meatus, the steps of the MAGPI procedure must be repeated or a different technique for hypospadias repair must be used.

b. Meatal stenosis usually is avoided by ensuring an adequate dorsal Heineke-Mikulicz tissue reconfiguration. To prevent meatal stenosis, it is essential that the dorsal incision is made from within the urethral meatus and extends distally into the urethral groove.

3. Reported results. A literature review indicates

Figure 5. Tunica albuginea plication. (A) An artificial erection is created and the degree of penile curvature is evaluated following release of all chordee. (B) Dorsal tunica albuginea plication is performed with care to preserve the overlying neurovascular bundles by elevating Buck's fascia flaps. Parallel incisions are made down to cavernous tissue, and the outer edges are approximated with sutures. (C) Artificial erection again is used to confirm straightening of the penile shaft. Reprinted with permission from Duckett JW: Successful hypospadias repair. Contemp Urol 1992;4:42–55. Copyright 1992 Medical Economics.
that MAGPI repair has well-documented, excellent functional and cosmetic results with a low complication rate. It is nearly exclusively performed as an outpatient procedure. Duckett and Snyder reviewed MAGPI hypospadias repair in 1111 patients and found the following.

a. Careful case selection is paramount to achieving excellent surgical results.

b. The procedure should be avoided in patients with thin or immobile ventral perimeatal skin or when the meatus is located too proximally.

c. A 2-layered glans closure is necessary to support the advanced ventral urethral wall and to prevent meatal regression.

d. A second procedure is required in 1.2% of cases.

B. **Perimeatal flap (Mathieu, “flip-flap”) procedure.**

This technique is effective for distal hypospadias with minimal chordee. The glanular urethral plate remains as the dorsal aspect of the distal urethra and the perimeatal skin flap form the ventral aspect of the neourethra. Success depends on adequate vascularization from perimeatal tissue. A caliper or metric ruler is useful for measuring and planning the incisions during this procedure.

1. **Surgical technique (Figure 10)**

a. A glans tip traction suture is placed.

b. The incision line of the glans flap is marked on each side of the glanular groove.

c. The strip of urethral plate should be 5 mm to 8 mm wide. The length of the flap corresponds to the distance between the meatus and the tip of the glans.

d. The proximal flap incisions should be made further apart (12 mm to 15 mm).

e. Employing the dartos layer as a pedicle for the flap enhances the blood supply.

f. A circumferential skin incision is made proximal to the coronal edge as an extension of each glans wing.

g. The glans wings are dissected from the corpora cavernosa on each side ventrally.

h. The flap is mobilized with its subcutaneous tissue attached and laid over the...
distal urethra (urethral plate).
i. The flap on each side is sutured with either running or interrupted absorbable suture material.
j. The deep tissue of the glans wings are sutured to the subcutaneous tissue of the flap.
k. The glans wings are approximated using layered suture lines over the urethral advancement.
l. Meatooplasty is performed with absorbable suture.
m. The circumcision defect is closed using either Byars flaps or a Z-plasty technique.
n. The urethra is calibrated using a bougie à boule or pediatric male sound. It is debatable whether to temporarily stent the urethra with an indwelling catheter sutured to the glans postoperatively.

2. Postoperative complications
a. Fistulas have been reported to occur in 6% of patients.
b. Meatal stenosis secondary to inflammation and contracture of the neomeatus occurs in approximately 3% of cases.

3. Reported results
a. Minevich and colleagues reviewed results of 202 Mathieu hypospadias repairs over a 5-year period. Urethral stents were used for postoperative drainage in all but 1 patient. Excellent cosmetic results were reported in 201 cases, with meatal retraction requiring reoperation in 1 patient. Two patients (or less than 1%) had urethrocutaneous fistulas, which were successfully repaired. There were no reports of urethral strictures. Minevich and colleagues concluded that the Mathieu repair provides excellent cosmetic and functional results with a minimal reoperation rate.
b. Uygur and colleagues reviewed 197 Mathieu hypospadias repairs performed over a 15-year period. The authors concluded that the surgeon’s experience is a critical factor impacting the success rate of hypospadias repair. Additional factors

Figure 7. Scrotoplasty. (A) and (B) The incisions are outlined. (C) The scrotal skin flaps are generously mobilized, and the bifid scrotum is corrected. (D) The skin is transposed to midline and excess tissue is excised. The base of the penis is closed to lateral abdominal skin. (E) Completed appearance. Reprinted with permission from Duckett JW: Hypospadias. In Campbell’s Urology, 7th ed. Walsh PC, Retik AB, Vaughan ED Jr, Wein AJ, eds. Philadelphia: WB Saunders, 1998:2112.
that were found to have a significant influence on success rates include the following.

1) Length of flap. Flaps less than 20 mm were associated with a higher success rate. This may be the result of the increased vascular demands of a larger flap in order to sustain viability.

2) Suture structure. Monofilament was associated with greater success rates than was multifilament, possibly because of decreased tissue reactivity.

3) Suture type. Repairs using 6-0 versus 5-0 suture were associated with greater success rates. The reason for this difference is unknown.

c. Hakim and colleagues compared surgical outcomes of stented and unstented Mathieu hypospadias repairs. In this retrospective review of 336 consecutive patients (114 with stented repairs, 222 with unstented repairs), none of the unstented cases was associated with urinary retention. There was no difference in fistula formation between the stented and unstented patients (2.63% versus 2.70%, respectively). Overall complication rates between the 2 cohorts showed no significant difference. The authors concluded that successful Mathieu hypospadias repair is independent of the use of a temporary postoperative stent.

c. Perimeatal tube (Mustarde) procedure This technique involves tunneling the neourethra in the glans, as opposed to covering it with glans wings. It is useful for hypospadias associated with mild chordee that necessitates dissection of the meatus from the ventral sulcus.

1. Surgical technique

a. A proximal ventral skin flap is marked 2 cm in width and long enough to reach the glans tip.

b. A circumferential skin incision is made proximal to the coronal edge but distal to the meatus.

c. A tunnel through the glans to its apex is created using fine tenotomy scissors. The tunnel must be spacious throughout its entire length so as not to constrict the neourethra.

d. The apical epithelium and glanular tissue are sharply excised to form the future meatal opening.

e. The skin flap is mobilized, maintaining as much subcutaneous tissue as possible to maximize vascularity.

f. The neourethra is tubularized over a catheter using absorbable suture.

g. The neourethra and stenting catheter should be gently drawn through the glans tunnel using traction sutures.

h. The dorsal aspect of the neourethra is

Figure 8. Surgical technique for meatal advancement and glanuloplasty (MAGPI) repair. (A) A circumferential subcoronal incision is made. (B) The bridge of tissue distal to the meatus is excised. (C) Heineke-Mikulicz closure widely opens up the meatus. (D) Subcoronal attachments are released to allow mobilization of tissue. (E) The ventral meatal edge is advanced with a skin hook, and glanular wings are drawn ventrally. (F) Excess glanular tissue is excised. (G) Deep glanular tissue is approximated followed by the superficial epithelial layer. (H) Skin is reapproximated. Reprinted with permission from Gonzales ET: Hypospadias repair. In Urologic Surgery, 4th ed. Glenn JF, ed. Philadelphia: JB Lippincott, 1991:822.
sutured to the dorsal glans apex on each side of the midline.

i. Any excess neourethra protruding through the glans tip is excised to make the meatus flush with the glans epithelium.

j. Meato-plasty is performed using absorbable suture.

k. Appropriate skin coverage may be performed using Byars flaps or alternative techniques.

2. Reported results. Klimberg and Walker examined results and complications of the Mustarde technique for 1-stage distal hypospadias repair in 20 patients. Follow-up was for more than 1 year. Cosmetic results were satisfactory. There was a urethral fistula rate of 15%, but no urethral strictures occurred.

D. Tubularized incised-plate urethroplasty.

Described by Snodgrass in 1994, this technique allows formation of a tension-free neourethra of normal caliber. The technique is both technically and cosmetically appealing for the correction of distal hypospadias.

1. Surgical technique (Figure 12)
   a. Three glanular traction sutures are placed.

Figure 9. Pyramid procedure used to repair the megameatus intact prepuce variant in circumcised patients. (A) Megameatus intact prepuce variant. (B) The megameatus and pyramid base are defined. The widened distal urethra is tapered. (C) The urethral plate is tubularized, forming a neourethra. The glans wings are reapproximated. Reprinted with permission from Retik AB: Proximal hypospadias. In Adult and Pediatric Urology, 3rd ed. Gillenwater JY, Grayhack JT, Howards SS, Duckett JW, eds. St. Louis: Mosby Year Book, 1996:2572.

Figure 10. Surgical technique for the perimeatal flap (Mathieu, flip-flap) procedure. (A) Skin flaps are marked prior to incision. (B) The ventral flap is mobilized with its vascular pedicle. (C) The glans wings are approximated, covering the neourethra. (D) Skin closure is completed. Reprinted with permission from Duckett JW: Hypospadias. In Campbell’s Urology, 7th ed. Walsh PC, Retik AB, Vaughan ED Jr, Wein AJ, eds. Philadelphia: WB Saunders, 1998:2103.
Figure 11. Surgical technique for the perimeatal tube (Mustarde) procedure. (A) A skin flap is marked and incised. (B) The prepuce is circumferentially incised proximal to the corona. A space is developed using dissecting scissors beneath the skin as shown. (C) A tunnel is developed through the glans using tenotomy scissors. (D) Using the tip of the tenotomy scissors as a marker, a generous divot of skin is removed at the location of the neomeatus. (E) The flap is freed from the corpora, leaving as much supporting vascularate as possible attached. The flap is tubularized over a catheter. (F) The tubularized flap is completed with the suture line positioned deep in the wound. (G) The skin tube and catheter are drawn through the glanular tunnel. The skin tube is sutured to the glans. (H) The end of the flap is trimmed obliquely to complete the neomeatus. Reprinted with permission from Hinman F Jr: Atlas of Urologic Surgery, 2nd ed. Philadelphia: WB Saunders, 1998:126–128.
b. The distal urethral quality is assessed using a pediatric male sound.
c. If necessary, the tissue is divided in the midline to the point where normal urethral tissue is encountered.
d. The urethral plate is marked and incised using a U-shaped incision.
e. Glans wings are developed using sharp dissection.
f. A vertical midline incision is made into the urethral plate extending to the glans tip.
g. Lateral mobility of the urethral plate halves should be apparent.
h. A 6-French catheter is placed through the meatus into the urinary bladder.
i. A tubularized neourethra is fashioned (Thiersch-Duplay technique) using a running, inverting Connell suture.
j. The glans wings are mobilized tension-free across the neourethra and approximated in the usual fashion.
k. Meatoplasty is performed to prevent meatal retraction.
l. Byars flaps are used to close the skin defect.
m. The catheter may be removed in the early postoperative period or later at the surgeon’s discretion.

2. **Postoperative complications**. There is a 12% overall complication rate.
   a. Urethrocutaneous fistula occurs in 5% of patients.
   b. Glanular skin dehiscence occurs in 5% of patients.
   c. Meatal stenosis occurs in 2.4% of patients.

3. **Reported results.** Staiman and Hensle used this technique in 41 consecutive patients with distal hypospadias. Fistula rates in this series, in which patients did not receive a preputial flap to cover the neourethral suture line, were comparable to rates in studies in which a preputial flap was used. The authors concluded that this repair could be performed without using a vascularized pedicle for coverage without compromising the surgical outcome.

E. **Onlay preputial flap**. This technique uses an island flap fashioned to the preserved urethral plate. It is ideal for patients in whom the meatus is too proximal for a perimeatal flap or in whom the ventral shaft skin is of poor quality and not suitable for a Mathieu procedure.

1. **Surgical technique** (Figure 13)
   a. A U-shaped incision is marked and then made around the meatus, extending distally to the glans tip on each side of the urethral plate.
   b. The remaining incision is completed circumferentially just proximal to the coronal edge, leaving the urethral plate intact.
   c. The shaft skin of the penis is degloved, and all fibrous chordee is released.
   d. An artificial erection is useful to evaluate the extent of curvature, and corrective techniques can be applied as needed.
   e. The glans wings should be dissected off the tips of the corporeal bodies on each side ventrally.
   f. A 4-point traction suture is used to display the ventral surface of the prepuce, which will aid in defining the flap.
   g. A preputial island flap is marked, incised, and mobilized larger than necessary (excess tissue can always be trimmed but the converse is not possible).
   h. A substantial pedicle is formed to maximize the vascular supply to the flap.
   i. The flap is rotated, and the edge closest to the pedicle is approximated to the urethral plate first.
   j. The flap is reassessed, and any excess skin is trimmed and discarded before closing the opposite side of the neourethra.
   k. The urethral caliber is evaluated with a bougie à boule or pediatric male sound.
   l. The glans wings are approximated together using a layered midline closure over the onlay flap.
   m. The pedicle is tacked over the anastomotic suture line of the neourethra to reduce the risk of fistula formation.
   n. A stented repair is recommended when performing the onlay preputial flap.
   o. The shaft skin defect is closed using the remaining preputial tissue as flaps.

2. **Postoperative complications**
   a. Fistulas are the most common postoperative complication.
   b. Urethral strictures can be caused by kinking at the suture line or by ischemia of the preputial onlay flap.
   c. Meatal stenosis can occur as a result of inflammation and tissue contraction.
Figure 12. Surgical technique for tubularized incised-plate urethroplasty. (A) The glans is injected with general anesthesia, traction sutures are placed, and the urethral plate is identified. (B) The urethral plate is outlined with a marking pen. (C) A U-shaped incision is made around the urethral plate, the lateral incisions are carried distally to the glans, and the glans wings are deeply incised. (D) The dorsal aspect of the urethral plate is sharply incised. (E) The urethral plate is tubularized around a catheter. (F) Glanuloplasty is performed. (G) Skin closure is completed. Reprinted with permission from Staiman VR, Hensle TW: Tubularized incised-plate urethroplasty. In Current Surgical Techniques in Urology, vol 10, no 5. Olsson CA, ed. Wilmington (DE): Medical Publications, Inc., 1997:3–5.
Figure 13. Surgical technique for the onlay preputial flap procedure. (A) The urethral plate is left intact in all cases. Skin incisions are outlined. The arrows indicate lengths that should be accurately measured using a ruler to ensure that an appropriately sized onlay flap is harvested. (B) A transverse preputial flap is mobilized on its vascular pedicle. (C) The flap is brought around ventrally. A lateral edge of the urethral plate is sewn to the flap. (D) and (E) A watertight closure of the flap to the remainder of the urethral plate is established over a catheter. (F) and (G) Glanuloplasty is performed in 2 layers. (H) Skin closure is completed. Reprinted with permission from Atala A, Retik AB: Hypospadias. In Reconstructive Urologic Surgery, 3rd ed. Libertino JA, ed. St. Louis: Mosby Year Book, 1998:467.
d. Persistent chordee occurs as a result of inadequate initial resection.
e. Pseudodiverticulum of the urethra occurs secondary to the original formation of a wide urethra.

3. Reported results
   a. Ghali compared onlay preputial island flaps with both the Mathieu procedure and tubularized preputial flaps. Over a 12-year period, a total of 418 patients were evaluated. Complication rates were greater in patients with severe hypospadias and with techniques requiring transection of the urethral plate. The onlay preputial island flap technique was more widely applicable than was the perimeatal based flap (ie, Mathieu) repair. The complication rate was lower for the onlay preputial island flap procedure than for the tubularized preputial island flap.

b. Rushton and Belman described a modification of the onlay preputial island flap repair, referred to as the split prepuce in situ onlay repair. The entire blood supply of the segment of prepuce used for the island flap is preserved. There was a 4% urethrocutaneous fistula rate in the series of 100 patients. A good cosmetic result was uniformly achieved. The authors concluded that this modification optimizes blood supply to the island flap and provides well-vascularized coverage of the neourethra.

c. Joseph and Perez performed tunica vaginalis onlay urethroplasty as a method of salvage repair. It was shown to have a substantial complication rate.

F. Tubed transverse preputial island flap typically is reserved for those patients with more significant chordee that necessitates resection or division of the urethral plate. It provides effective repair for proximal (ie, penoscrotal) hypospadias.

1. Surgical technique (Figure 14)
   a. The dorsal and lateral coronal sulci are marked and incised, extending the incision proximally in a U-shaped fashion around the meatus.
   b. The shaft is degloved.
   c. Any chordee is corrected; if necessary, the urethral plate is excised.
   d. Using traction sutures, the inner prepuce is fanned out, and the appropriately sized island flap is marked.
   e. A well-vascularized pedicle is developed down to the base of the penile shaft.
   f. The flap is rolled over a 12-French catheter, creating a circular anastomosis with interrupted sutures at each end to enable trimming.
   g. The tubularized flap is rotated ventrally and anastomosed to a spatulated urethra.
   h. The suture line of the tubularized flap should lie dorsally against the corporeal groove.
   i. A glans channel is created as previously described or, alternatively, the glans is split to form glans flaps.
   j. The neourethra should be drawn through the glans channel with traction sutures and excess length should be excised.
   k. To prevent kinking of the tubed flap, the tube should be sutured to the corporeal bodies along the penile shaft.
   l. Meatooplasty should be performed using interrupted absorbable sutures.
   m. The repair should be stented using a catheter or silicone tube.
   n. Pedicle tissue should be tacked to cover the urethral anastomosis.
   o. The skin defect should be closed using the remaining preputial tissue.

G. Tube graft (bladder mucosa) is indicated for complex cases (ie, patients in whom the preputial skin is insufficient for repair).

1. Surgical technique
   a. A catheter should be inserted into the bladder, and the bladder should be distended with saline.
   b. Through a transverse lower abdominal incision, the anterior surface of the bladder should be exposed.
   c. The detrusor muscle should be dissected from the urothelium, and a suitably sized graft should be marked.
   d. The graft should be excised sharply with
fine-tip scissors and immediately rolled around a 12-French catheter and sutured, ensuring that the graft is kept moist at all times.

e. The catheter and graft should be inverted.
f. The graft should be anastomosed first to the glans and then to the spatulated urethral stump, with the catheter in the urethral stump as a guide.
g. Appropriate skin coverage should be provided using previously described techniques (ie, Byars flaps).
h. The penis should be immobilized with a pressure dressing.
i. The bladder should be closed using a Malecot catheter for suprapubic diversion.
j. The catheter or stent should be left in place for a minimum of 10 days postoperatively.

2. Postoperative complications
   a. Meatal stenosis may occur secondary to inflammation and tissue contracture.
   b. Meatal eversion problems occur when the bladder mucosa is used at the distal meatus.
   c. Diverticula may form as a result of configuring the neourethra too widely.
   d. Strictures may develop due to contracture at the anastomotic suture line.

3. Reported results. Kinkead and associates reported the long-term follow-up of bladder mucosal graft procedures for male urethral reconstruction. A total of 95 patients were evaluated with a mean follow-up of 3.4 years. Of the 95 patients, 66% required between 1 and 9 additional procedures to treat complications before achieving a good result. Meatal stenosis and meatal prolapse were among the most common postoperative complications. The authors recommended that bladder mucosa should not be incorporated as a circumferential terminal urethral segment. Significant morbidity has been reported with the graft harvesting procedure.

H. Tube graft (buccal mucosa). Indications for the tube graft using buccal mucosa are identical.
to those described for the tube graft using bladder mucosa. The buccal mucosa is readily available and has physical properties beneficial to free graft survival. Buccal mucosal grafts are preferred over bladder mucosal grafts because of their abundant vascularity beneath the epithelial basement membrane. Cheek grafts may be harvested wide enough to allow tubularization, as opposed to grafts harvested from the inner lip.

1. **Surgical technique (Figure 15)**
   a. The patient may be intubated with an endotracheal tube taped to the side opposite from the planned harvest site, or nasal tracheal intubation may be performed.
   b. A self-retaining retractor provides excellent exposure.
   c. Lidocaine with epinephrine may be injected submucosally to facilitate dissection.
   d. The parotid (Stenson’s) duct must be identified and preserved.
   e. Fine traction sutures should be used at the 4 corners of the graft to aid in dissection and to minimize instrument trauma.
   f. The graft should be dissected just beneath the submucosa; hemostasis

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**Figure 15.** Surgical technique for a tube graft from buccal mucosa. (A) The inner cheek is harvested with attention to avoid injury to Stenson’s duct located opposite the second molar. (B) The graft may be tubularized for urethral replacement or used as an onlay. (C) The graft is sutured into place forming a neourethra. Note that the epithelium of buccal mucosa is 4 times thicker than normal skin or bladder mucosa. Reprinted with permission from Duckett JW: Successful hypospadias repair. *Contemp Urol* 1992;4:42–55. Copyright 1992 Medical Economics.
should be obtained, followed by closure of the cheek wound.

g. Pinning the graft on a board is helpful for preparing the graft.
h. The graft should be defatted sharply and rolled over an appropriately sized catheter, with the mucosal surface facing the catheter tubing.
i. A running closure should be performed with interrupted sutures at each end of the tube.
j. An inverted, oblique urethral anastomosis is performed, with the suture line of the graft positioned dorsally.
k. To prevent kinking, the graft should be tacked to the corporeal bodies.
l. A glans channel or glans wings and complete closure should be performed as previously described.
m. A catheter or stent is recommended postoperatively for 1 week.
n. Suction drainage in the immediate postoperative period may prevent hematoma formation.
o. An immobilizing pressure dressing should be placed, and the patient should be placed at bed rest for 48 hours.

2. Postoperative complications
   a. Damage to the parotid duct or buccal neurovascular bundle may occur.
   b. The chance of late complications is lower with buccal mucosal than with bladder mucosal grafts.
   
3. Reported results. Caldamone and colleagues reported 3 centers’ experience with the use of buccal mucosa for urethroplasty. The results of 22 urethral reconstructions using buccal mucosa were evaluated. Onlay grafts were used in 6 cases and tubularized grafts in 16 cases. The authors concluded that buccal mucosa is an excellent source of graft material for urethral reconstruction in cases of complex hypospadias.

X. POSTOPERATIVE CONSIDERATIONS

A. Postoperative dressing immobilizes the repair and promotes hemostasis, which minimizes edema.
   1. Unstented repairs. Bio-occlusive dressings are effective for the majority of unstented distal repairs.
   2. Stented repairs are best covered using a “sandwich” pressure dressing with the penis immobilized against the abdominal wall.

B. Postoperative analgesia
   1. Acetaminophen or acetaminophen with codeine elixir typically provides satisfactory pain relief. Codeine should be avoided before 1 year of age because of the unpredictable response to narcotic analgesics in this age-group.
   2. Bladder spasms may be successfully managed with oxybutynin.

C. Prevention and management of postoperative complications (Table)
   1. Urethrocutaneous fistula is an inherent risk of hypospadias repair.
      a. Epidemiology. The occurrence rate is 5% to 10% for 1-stage repairs. The failure rate after repair of initial urethrocutaneous fistula ranges between 40% and 50%. Generally, the more complex the fistula, the greater the recurrence rate.
      b. Etiology and prevention. Urethrocutaneous fistulas may be the hallmark of a significant problem in the urethra. Basic surgical principles, such as avoiding overlapping suture lines, a multilayered closure, and interposing healthy tissue over the urethroplasty, are essential. Small adjacent rotational or transpositional flaps are helpful.
      c. Repair. It is recommended that fistula repair be delayed until 6 months after the time of initial urethroplasty.
         1) Use of the operating microscope is helpful for small fistulas.
         2) The fistula tract should be sharply excised, and a watertight repair of the epithelium should be completed with careful tissue mobilization and a multilayered closure (Figure 16).
         3) Large fistulas often necessitate wide dissection to accomplish a multilayered closure.
         4) Urinary diversion is not necessary.
         5) A frequent error in repair is failure to recognize a coexisting distal stricture (ie, meatal stenosis) or diverticulum.
a) The diverticulum should be excised at the time of fistula repair.
b) Meatoplasty should be performed, if necessary, along with fistula repair.

2. **Persistent chordee** is the most common problem following hypospadias repair.49
   a. **Etiology.** Persistent chordee may result from incomplete excision of the ventral dysgenetic fibrous tissue, or it may be a function of corporeal disproportion. Frequently, persistent chordee accompanies other complications (eg, hematoma, graft contraction, flap ischemia). Scarring increases with multiple surgeries and contributes to the persistence or development of chordee.
   b. **Repair**
   1) Any dysgenetic or scarred tissue must be excised.
   2) If chordee persists, a dorsal tunica albuginea plication may be attempted.
   3) More extensive dissection may be necessary and involves elevating the urethra from the ventral penile shaft with graft placement at the ventral tunica albuginea (Figure 17).
   4) A scarred urethra must be reconstructed.

3. **Failure of the neourethra** usually presents a demanding challenge to the hypospadias surgeon. Strictures following hypospadias repair are seldom cured with dilation alone. Visual internal urethrotomy also is rarely curative; occasionally it is successful with discrete anastomotic strictures. Onlay repairs appear to be superior to tubed techniques with respect to urethral viability and function.
   a. **Salvage techniques**
   1) Dorsal redundant skin may be a source of tissue for ventral transfer.
   2) If a flap cannot be used in the urethral reconstruction, a staged approach is recommended.
   3) The Mathieu procedure is a reliable form of secondary flap reconstruction for distal urethral stenosis.
   4) Islands of scrotal skin that do not bear hair have been used for repair of strictures in the proximal urethra, especially when no other tissue is available for transfer. Scrotal skin islands should be used only as an onlay and not for tubed repairs. The scrotum is an unreliable donor site in the prepubescent patient.
   b. **Graft repairs**
   1) The host recipient bed must have sufficient vascularity for any graft to take. This can present a challenge in

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**Table. Errors That May Result in a Failed Hypospadias Repair**

<table>
<thead>
<tr>
<th>Errors in design</th>
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<tbody>
<tr>
<td>Chordee inadequately resected</td>
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<tr>
<td>Surgical exposure inadequate</td>
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<tr>
<td>Urethra constructed with hair-bearing skin</td>
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<tr>
<td>Neourethra of inappropriate diameter (too large or too small)</td>
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<tr>
<td>Apposing suture lines</td>
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<tr>
<td>Narrow urethral meatus</td>
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<tr>
<td>Skin graft from improper site</td>
</tr>
<tr>
<td>Split thickness skin for the urethra</td>
</tr>
</tbody>
</table>

**Errors in technique**

| Everted urethral epithelium, inverted skin |  
| Skin edges traumatized by instruments |  
| Inadequate hemostasis |  
| Flaps with poor blood supply |  
| Tension on flaps |  
| Improper suture material |  
| Improper use of drain |  
| Inelastic stent tube |  

**Errors in postoperative care**

| Dressing too tight or on too long |  
| Meatal encrustation with bloody secretions |  
| Urine drainage into the wound |  
| Bladder spasm |  
| Catheter obstruction |  
| Constipation |  
| Hematoma not drained |  
| Infection not controlled |  
| Improper repair of complications |  

the patient undergoing several attempts at reconstruction.

2) Transposition of vascular tissue (ie, tunica vaginalis) to the ventral penile shaft may improve the potential for success.

3) Tubed graft repairs should be avoided if at all possible.

4) Donor sites include penile skin, bladder epithelium, buccal mucosa, and postauricular full-thickness skin. The most frequent graft sites currently in use appear to be penile skin and buccal mucosa.
   a) Poor results have been associated with the use of extragenital skin in urethral revision.
   b) Graft contraction rates may be as high as 10% to 15% for penile skin, buccal mucosa, and postauricular skin.
   c) Bladder epithelial grafts have a tendency to be redundant; however, it is debated whether this occurs following transfer or if this is simply a function of the harvesting technique.

c. Urinary diversion occasionally is used in the management of severe acute or chronic stenosis of the neourethra. A proximal urethrostomy does not need to be a perineal urethrostomy. A small V-flap created just proximal to the neourethra frequently is successful. This provides an alternative to repeated instrumentation of the child in attempt to correct a doomed primary urethroplasty.

d. Staged repairs. Preferably, donor grafts are used from a hairless site. The mesh split-thickness skin graft has been a useful entity in complex reconstruction operations. Residual chordee should be excised at the time of graft placement.

Figure 16. Surgical technique for multilayered closure used after repair of a urethrocutaneous fistula. (A) The fistula tract is dissected and sharply excised at the level of the urethra. (B) A watertight closure of the urethra is performed. (C) Subcutaneous tissue is mobilized, and an additional layer is used to cover the urethral repair. (D) Skin closure is completed. Reprinted with permission from Hinman F Jr: Atlas of Urologic Surgery, 2nd ed. Philadelphia: WB Saunders, 1998:110.
Grafts are supported by the improved vascularity of tissue transfers (ie, tunica dartos flap or tunica vaginalis flap). Grafts may take up to 12 months to mature and allow tubularization. Staged mesh graft repairs have not been plagued by the high fistula rates associated with the early techniques of staged redo urethroplasty.

e. **Urethral diverticulum** is most commonly seen in conjunction with distal urethral obstruction, causing high-pressure micturition. The distal obstruction must be corrected prior to addressing the diverticulum. A cautious approach to diverticulum repair is essential, as these tissues are prone to contraction.

f. **Wound infection.** Prophylactic use of antibiotics has not been conclusively justified in the literature and is usually at the discretion of the surgeon. Preventive measures, such as preoperative release of adherent foreskin and removal of debris before skin preparation, are encouraged. Most superficial wound infections are successfully managed by

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**Figure 17.** Technique of graft placement at the ventral tunica albuginea to manage severe chordee. (A) A dermal graft is harvested and trimmed. (B) Artificial erection is used to define the extent of penile curvature. The urethra is elevated off the ventral tunica albuginea. A patch of tunica albuginea is excised ventrally. (C) The graft is sutured into place. Reprinted with permission from Retik AB: Proximal hypospadias. In *Textbook of Operative Urology*, Marshall FF, ed. Philadelphia: WB Saunders, 1996:980.
antibiotics directed at skin flora in conjunction with local wound care.

g. **Urinary tract infection.** Antibiotic suppression is recommended for patients in whom urinary diversion is used postoperatively. A clean-catch urine culture should be repeated 2 weeks after catheter removal if irritating voiding symptoms persist.

h. **Balanitis xerotica obliterans** is believed to be secondary to chronic inflammation. Corticosteroid injections have shown promise in short-term management. Infrequently, excision of the lesion and meatoplasty is necessary.51

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**BOARD REVIEW QUESTIONS**

Choose the single best answer for each of the following questions.

1. **Which of the following statements concerning hypospadias is FALSE?**
   A) Hypospadias is a congenital anomaly.
   B) The severity of hypospadias is defined by the original position of the meatus prior to release of any associated chordee.
   C) There is no standard method for repairing all hypospadias cases.
   D) The preputial defect associated with hypospadias consists of a deficient ventral segment and resultant dorsal hood.
   E) A surgical goal of hypospadias repair is to permit the patient to have a straight urinary stream.

2. **Which of the following statements regarding the epidemiology of hypospadias is FALSE?**
   A) Cryptorchidism is an associated anomaly in approximately 9% of patients.
   B) Familial tendencies have been reported.
   C) Incidence has been reported to be approximately 1 in 300 live male births.
   D) Hypospadias is more common among Caucasians than among African Americans.
   E) Midpenile hypospadias is more common than anterior hypospadias.

3. **Which of the following statements regarding anomalies associated with hypospadias is correct?**
   A) The most common anomalies associated with hypospadias are inguinal hernias and cryptorchidism.
   B) Screening of the upper urinary tract is indicated in a patient with hypospadias and an inguinal hernia.
   C) Patients with perineal or penoscrotal hypospadias have a 10% to 15% incidence of enlarged utricle.
   D) Renal anomalies are commonly associated, and all patients presenting with hypospadias require radiographic evaluation of the kidneys.

4. **Which of the following statements regarding the preoperative evaluation of the patient with hypospadias is correct?**
   A) Previous circumcision has no implications on future surgical plans to correct hypospadias.
   B) Voiding studies are indicated before all hypospadias repairs.
   C) The finding of cryptorchidism should alert the examiner to the possibility of an intersex disorder.
   D) All patients with perineal hypospadias should undergo karyotyping preoperatively.

5. **Which of the following statements regarding orhoplasty (straightening) of the penis is FALSE?**
   A) The use of artificial erection is indicated before as well as after orhoplasty.
   B) Normal saline is used to produce artificial erection because penile necrosis may result from the inadvertent injection of 50% saline solution.
   C) Corporeal disproportion can be corrected by performing a tunica albuginea plication.
   D) The neurovascular bundles are routinely sacrificed during a tunica albuginea plication.

6. **Which of the following statements regarding the Mathieu procedure is FALSE?**
   A) The length of the flap equals the distance between the meatus and the glans tip.
   B) Success depends on adequate vascularization of the perimeatal tissue.
   C) Universally poor results have been reported without the postoperative use of urinary diversion.
   D) The procedure is used for relatively short defects in which healthy ventral shaft skin tissue exists.
   E) Lateral glans wings are commonly closed over the urethral advancement.
7. Which of the following is NOT an accepted method for maintaining hemostasis perioperatively for hypospadias repair?
A) A tourniquet at the base of the penis released once every hour
B) 1:100,000 epinephrine in 1% lidocaine for cutaneous infiltration
C) Caudal anesthetic blockade
D) Meticulous bipolar electrocautery
E) Sandwich dressing applied for 48 hours postoperatively

8. Stensen’s duct must be identified and avoided during which type of hypospadias repair?
A) Meatal advancement and glanuloplasty (MAGPI) procedure
B) Onlay island flap
C) Mathieu procedure
D) Buccal mucosal graft
E) Bladder mucosal graft

9. Which of the following statements regarding the complications of hypospadias repair is correct?
A) The use of hair-bearing skin for urethroplasty does not increase the risk of stone formation.
B) Poor wound healing usually is the result of a superficial wound infection.
C) Prophylactic antibiotics have been shown to be effective in preventing wound infections in randomized double-blind studies.
D) Second procedures required to close a urethrocutaneous fistula typically carry failure rates up to 10%.
E) None of the above

10. Which of the following statements regarding urethrocutaneous fistulas is FALSE?
A) Urethrocutaneous fistula is an inherent risk of any hypospadias repair.
B) Testosterone has been found to decrease the incidence of urethrocutaneous fistula formation.
C) A common error in repair is failure to recognize a coexisting distal stricture or diverticulum.
D) Meatal stenosis requires a meataloplasty in conjunction with the fistula repair.
E) Avoidance of overlapping suture lines and interposition of healthy tissue between the neourethra and the skin are invaluable techniques in preventing fistulas.

11. Which of the following statements regarding hypospadias repair is FALSE?
A) Meticulous tissue handling under magnification is important in the repair of complications of primary urethroplasty.
B) Scared structures must not be excised in secondary operations because the tissue blood supply may be compromised.
C) Hair-bearing skin should be avoided in urethral construction.
D) Urethral epithelium should be inverted and skin should be everted during repair.

12. A 1-year-old infant is brought in for evaluation of hypospadias. On physical examination, the patient is noted to have perineal hypospadias associated with penoscrotal transposition and a nonpalpable testicle. Which of the following is the next best step in the management of this patient?
A) Repair the hypospadias initially and perform orchiopexy as a separate procedure.
B) Perform orchiopexy and repair the hypospadias in 1 operation.
C) Obtain a pelvic ultrasound.
D) Initiate a trial of intramuscular testosterone administration.
E) None of the above. A perineal hypospadias cannot be repaired when it is associated with penoscrotal transposition.

13. Upon completion of a transverse island tube urethroplasty for a posterior hypospadias, the catheter accidentally falls out. The surgeon is unable to replace a catheter into the urinary bladder. Which of the following is the most appropriate next step?
A) Place a percutaneous suprapubic tube.
B) Dissect into the perineum and identify and resect the urethra that is preventing passage of the catheter.
C) Stent the repair to the level of the urethra and place a percutaneous suprapubic tube.
D) Perform a temporary vesicostomy.

14. At the completion of a proximal hypospadias repair, there is a question of dead space and the potential for the development of a hematoma. Which of the following is the best management in this scenario?
A) Place a tight pressure dressing for 72 hours.
B) Drain the wound.
C) Cauterize the dead space with monopolar cautery and close the space primarily with sutures.
D) Admit the patient and observe the repair for 24 hours for the development of hematoma.
15. A pediatrician refers a 2-year-old child with a distal hypospadias fistula following a midshaft hypospadias repair 8 weeks ago. The patient’s family has just relocated to the area and requests that the hypospadias fistula be repaired immediately. Which of the following is the most appropriate response to the parents’ request?
A) Schedule the child for immediate repair.
B) Tell the parents that repair of a hypospadias fistula typically has a >95% success rate.
C) Inform the parents that the patient would be best served by waiting a minimum of 6 months from the time of the initial hypospadias repair to correct the fistula.
D) Recommend immediate urinary diversion with a suprapubic tube and schedule the surgery for 1 year from the initial hypospadias repair.

16. When performing an artificial erection, the correct solution to be used by the surgeon is:
A) Normal saline
B) Lidocaine with epinephrine
C) Sterile water
D) Lidocaine without epinephrine

17. A 4-year-old boy complains of persistent irritative voiding symptoms 2 weeks following the removal of the indwelling catheter used during his recent hypospadias repair. The next best step is to:
A) Obtain a clean-catch urine sample for culture
B) Reassure the patient and parents that this is part of the normal postoperative course
C) Perform cystoscopy
D) Start oxybutynin
E) Perform a voiding cystourethrogram

18. In the embryologic development of hypospadias, defective mesenchyme may result in malformation of all of the following structures EXCEPT:
A) Buck’s fascia
B) Ventral shaft skin
C) Ventral tunica albuginea of the corpora cavernosa
D) Corpus spongiosum
E) Neurovascular bundle complex

19. Which of the following statements regarding hypospadias repair is FALSE?
A) A noncompliant meatus is a contraindication to performing a MAGPI repair.
B) Bladder mucosal tube grafts are useful in cases in which preputial skin is insufficient for hypospadias repair.
C) Buccal mucosal grafts have been criticized in the literature because of the poor vascularity beneath the epithelial basement membrane.
D) The development of the external genitalia and upper urinary tract is asynchronous.
E) Minimizing psychological damage is an important consideration when choosing an age for hypospadias repair.

ANSWERS

15. (C) 16. (B) 17. (A) 18. (D) 19. (A)

EXPLANATION OF ANSWERS

1. (B) The severity of hypospadias is defined by the original position of the meatus prior to release of any associated chordee. This statement is false. The severity of hypospadias is defined by the position of the meatus following the release of any associated chordee.

2. (E) Midpenile hypospadias is more common than anterior hypospadias. This statement is false. Anterior hypospadias is the most common form of hypospadias, followed by midpenile and posterior locations.

3. (A) The most common anomalies associated with hypospadias are inguinal hernias and cryptorchidism. An increased incidence of clinically significant upper urinary tract anomalies has not been demonstrated with isolated hypospadias. Screening of the upper urinary tract is not indicated in patients with hypospadias alone with or without undescended testes or inguinal hernia.

4. (C) The finding of cryptorchidism should alert the examiner to the possibility of an intersex disorder. Technical details or complications of any previous genital surgery, including circumcision, have significant implications in planning surgical options.
Hypospadias

Voiding studies are rarely indicated prior to repair of hypospadias. Karyotyping is necessary only in select cases of hypospadias in which intersex is suspected.

5. (D) The neurovascular bundles are routinely sacrificed during a tunica albuginea plication. This statement is false. The neurovascular bundles are elevated off the tunica albuginea and preserved prior to plication during orthoplasty.

6. (C) Universally poor results have been reported without the postoperative use of urinary diversion. This statement is false. Although Duckett has recommended urinary diversion with a 6-French urethral catheter for 5 to 7 days, others have achieved excellent results without diversion.

7. (A) A tourniquet at the base of the penis released once every hour. This is not an accepted method for maintaining hemostasis perioperatively for hypospadias repair. When used for hemostasis, a tourniquet at the base of the penis should be released every 20 to 30 minutes.

8. (D) Buccal mucosal graft. During the cheek harvest for a buccal mucosal graft, Stensen’s duct must be identified and avoided.

9. (E) None of the above. The use of hair-bearing skin for urethroplasty increases the risk of stone formation and encrustation. Poor wound healing often is secondary to ischemic flaps. Prophylactic antibiotics have not been documented to prevent wound infections in hypospadias repairs in randomized double-blind studies. Second procedures required to close a urethrocutaneous fistula typically carry failure rates up to 40%.

10. (B) Testosterone has been found to decrease the incidence of urethrocutaneous fistula formation. This statement is false. Testosterone has not been demonstrated to reduce the risk of urethrocutaneous fistulas. Urethrocutaneous fistula is an inherent risk of any hypospadias repair. A common error in repair is failing to recognize a coexisting distal stricture or diverticulum. Avoiding overlapping suture lines and interposing healthy tissue between the neourethra and the skin help to prevent fistulas. Mental stenosis requires a meataloplasty in conjunction with the fistula repair.

11. (B) Scarred structures must not be excised in secondary operations because the tissue blood supply may be compromised. This statement is false. In secondary operations, it is recommended that all scarred tissues be resected. Scarred structures characteristically carry a paucity of blood.

12. (C) Obtain a pelvic ultrasound. Any patient who presents with proximal hypospadias and cryptorchidism must be evaluated for intersex. A pelvic ultrasound is useful to screen for female internal organs. A chromosome analysis also is a reasonable initial step.

13. (C) Stent the repair to the level of the utricle and place a percutaneous suprapubic tube. As many as 30% of patients with perineal hypospadias will be found to have a utricle. This may make catheterization of the urinary bladder a difficult task. The most desirable option listed is to stent the repair past the proximal anastomosis and divert the urine via a suprapubic tube.

14. (B) Drain the wound. If there is any question of dead space, hematoma, or seroma, the wound should be drained. Extensive cauterization using a monopolar cautery will result in a significant field effect and should be avoided entirely.

15. (C) Inform the parents that the patient would be best served by waiting a minimum of 6 months from the time of the initial hypospadias repair to correct the fistula. The minimum waiting period to repair a hypospadias fistula should be 6 months. This allows a chance for the initial repair to heal and the viability of the tissues to be confirmed. The surgeon can then approach the fistula repair with knowledge of the quality and availability of tissues for flaps to maximize success.

16. (A) Normal saline. An artificial erection is created by injecting normal saline into the corporeal body with a proximal tourniquet in place.

17. (A) Obtain a clean-catch urine sample for culture. The best step in the management of this patient is to perform a clean-catch urine culture to rule out the presence of a urinary tract infection.

18. (E) Neurovascular bundle complex. The abnormal mesenchyme development in hypospadias causes malformation of each of the structures listed except the neurovascular bundle complex. The formation of the neurovascular bundle has not been shown to be affected by the same embryologic pathways associated with hypospadias formation.

19. (C) Buccal mucosal grafts have been criticized in the literature because of the poor vascularity beneath the epithelial basement membrane. This statement is false. Buccal mucosal grafts are preferred over bladder mucosal grafts because of their abundant vascularity beneath the epithelial basement membrane.

REFERENCES


38. Kirsh AJ, Cooper GS, Snyder HM: The onlay island flap


