Hypospadias Repair

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Introduction

- Hypospadias is one of the most common congenital anomalies (0.3% of males) with wide geographic variability in incidence
- It's embryonic basis is considered arrested development
- Etiology is multifactorial… endocrine (defect in androgen, hcG) environmental (maternal exposure) genetic (first degree relatives)
- 90% of cases are isolated hypospadias (10% can be syndromic)
- A variety of techniques have been developed for the repair (>300), as a result of the multiple complications

Outline

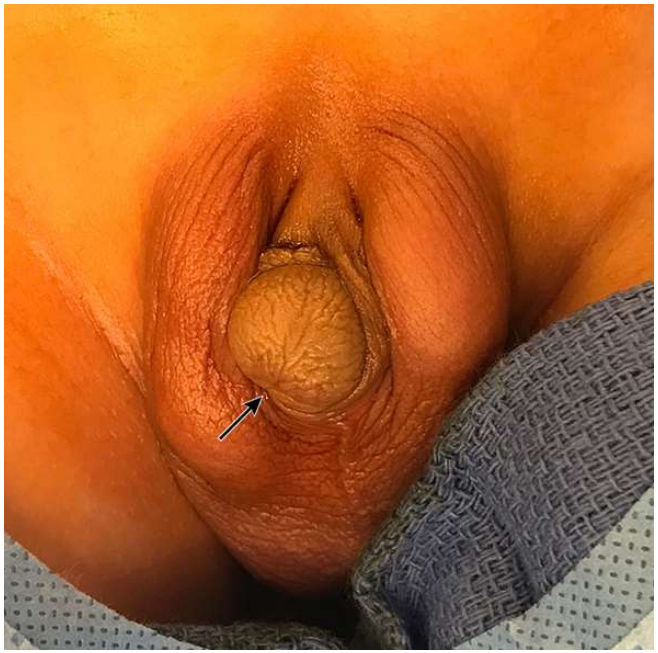
1. Preop considerations
2. Intraoperative considerations
3. Surgical techniques
4. Postop considerations
5. Complications
6. Experience from Ethiopia

1. Preop considerations

Genital examination

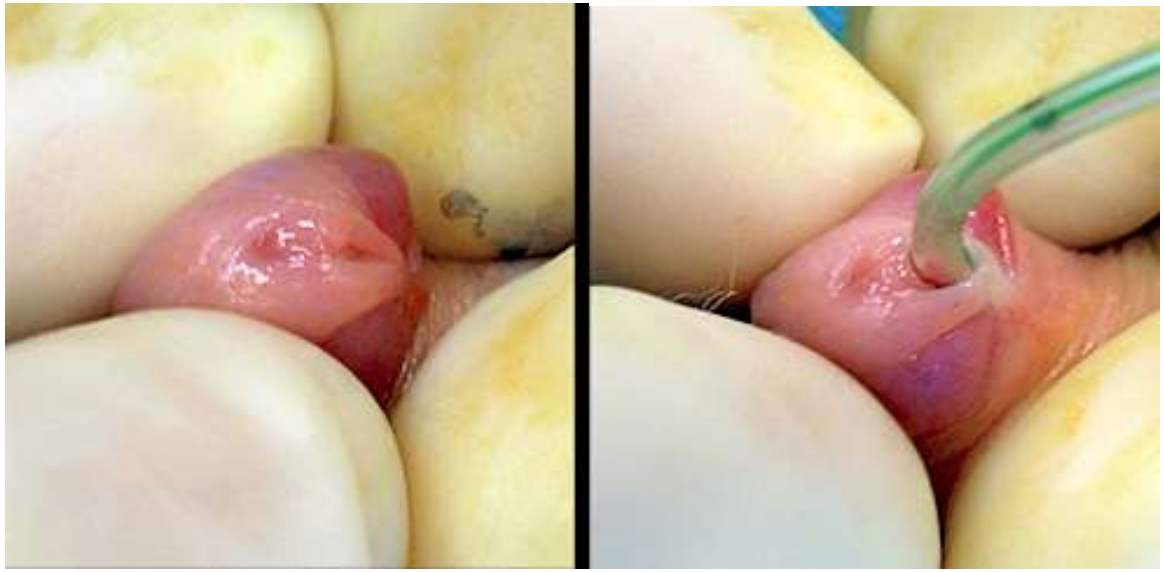
- **Standard hypospadias (40% distal**=corona and above**, 20% proximal):** ventral prepuce deficiency (dorsal hood), proximal meatus, glans separation, Downward glans tilt, ventral curvature, Deviation of the median penile raphe

Genital examination



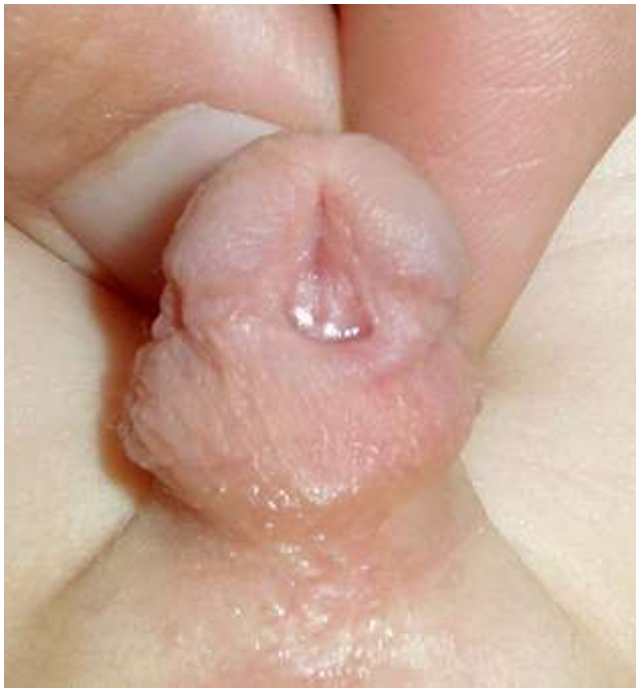
- **Severe hypospadias (20%) -** glans <14mm, penoscrotal transposition, ventral tethering (fusion of foreskin to scrotum): *usually require endocrine evaluation (for DSD) and a staged procedure*

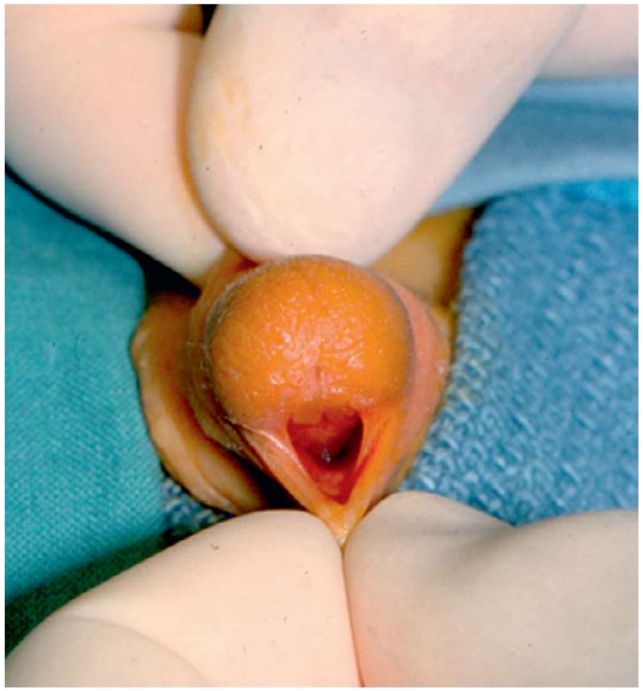
Genital examination



- **Forme fruste of hypospadias (10%) -** *clinically insignificant hypospadias (1-2mm proximal meatus) with blind urethral pit, no chordee (No correction needed)*

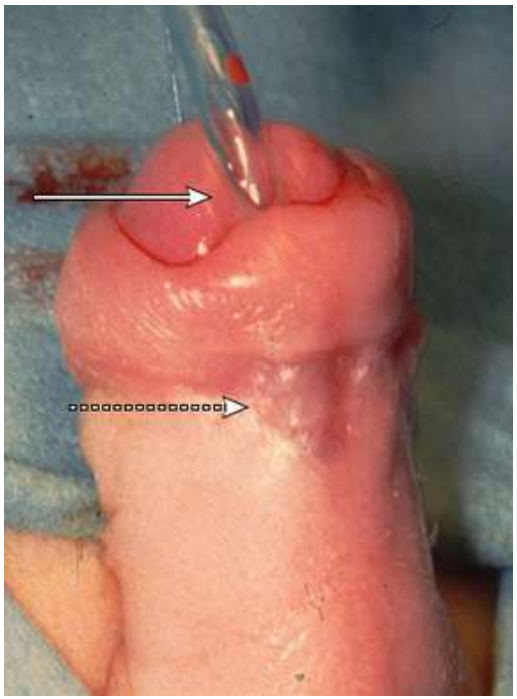
Genital examination





- **Other variants (5%):** megameatus Intact prepuce (MIP) **-** *wide meatus found after circumcision (??can undergo the circumcision without concern)*

Genital examination



- **Other variants (5%):** Chordee without hypospadias

Investigations

- karyotyping is indicated for hypospadias with undescended testes (especially proximal with non-palpable)
  - Also suspect in micropenis and in penoscrotal transposition
- Urinary tract Imaging is not indicated (regardless of severity)
  - ?US and VCUG for penoscrotal and perineal hypospadias.

Age at repair

- Anesthetic risk (bronchospasm) - 3mo (term), 56 wk (preterm)
- Psychosexual factors – ? 18 mo (genital awareness)
- surgical complications - Increase with age in various reports, what age?
  - *Sarhan (2009) – not an independent risk factor*
  - *Essa (2011) – age at repair **> 4 years** has increased risk of complications*
  - *Bush, snodgrass (2012, 2013) - **not an independent risk factor***

Androgen stimulation

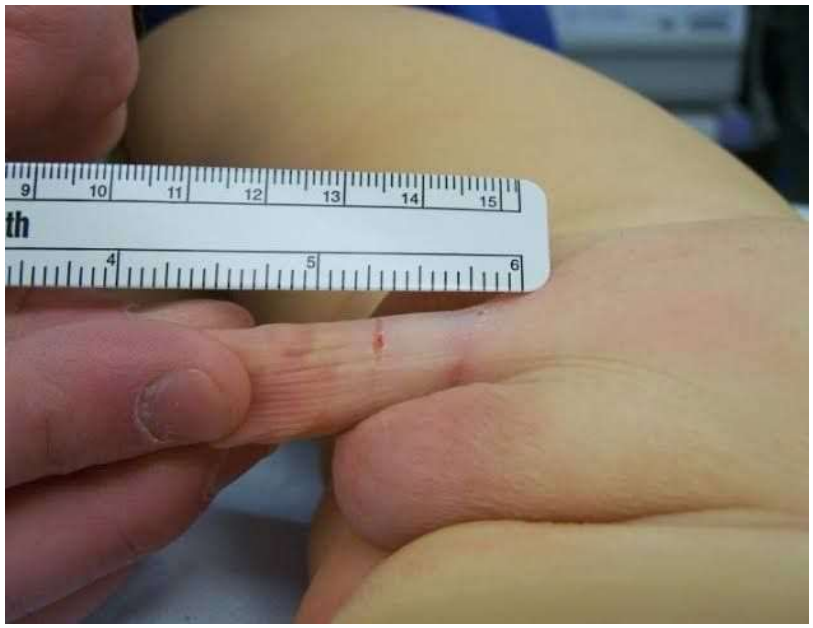
- Androgen increase penile length and glans circumference
- *Kaya (2008)*
  - **topical dihydrotestosterone** (2.5% to glans and shaft daily for 3 months)
  - **Significant reduction in complication**
- *Bush, Snodgrass (2013, 2014)*
  - **testosterone injection** 2 mg/kg for 2 or 3 doses … 2 to 32 mg/kg per injection based on re-measurement 1 month after each injection.
  - **Higher complication remained** in those who took adjuvant treatment

2. Intraop considerations

General considerations & penile assessment

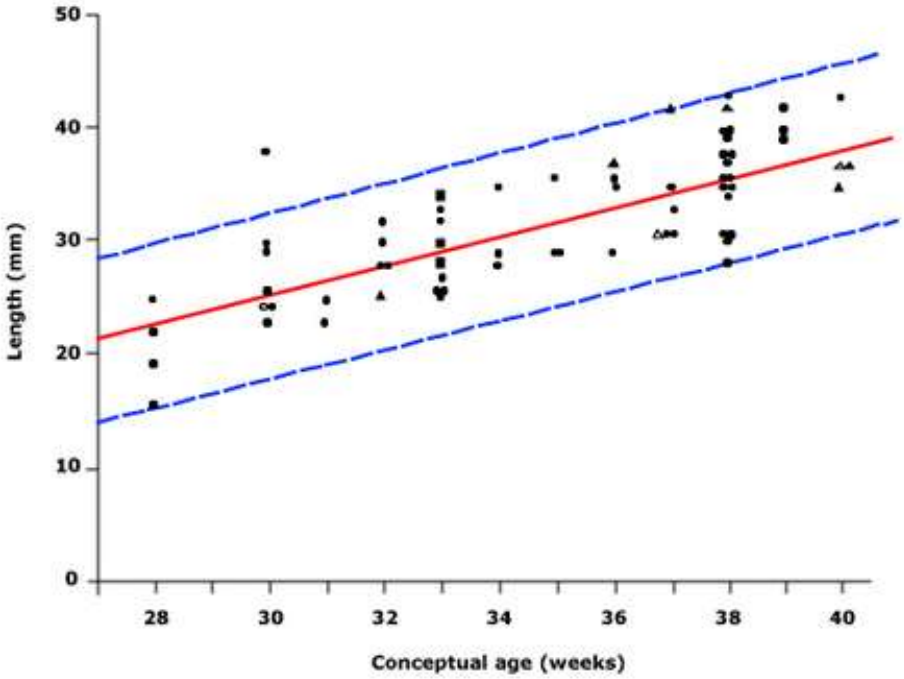
- Antibiotics – IV cefazolin (? If buccal mucosa harvest)
- Nerve block – for distal penile block, for proximal caudal is preferred
- Plate assessment - >8mm for TIP Vs not a contraindication for TIP
- Ventral curvature asssesment - <30 degree for TIP

Penile assessment



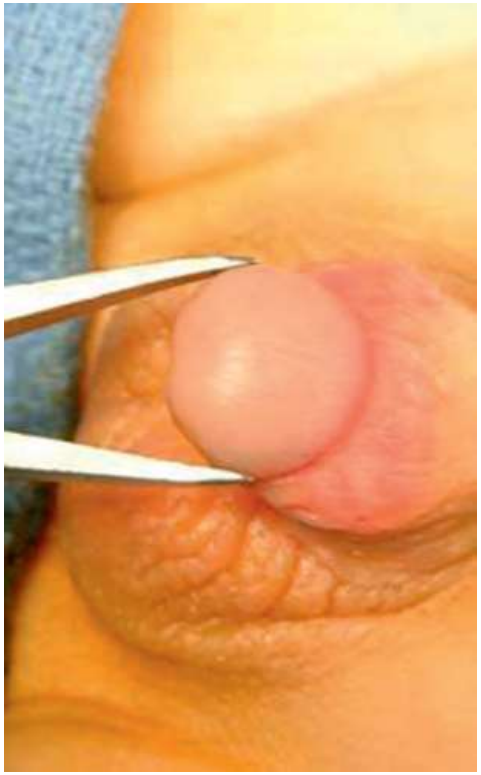
- Measuring stretched penile length: glans penis is held with the thumb and forefinger and penis stretched until increased resistance. using a **ruler or caliper** from pubic ramus to tip of the glans (dorsal)

Penile assessment



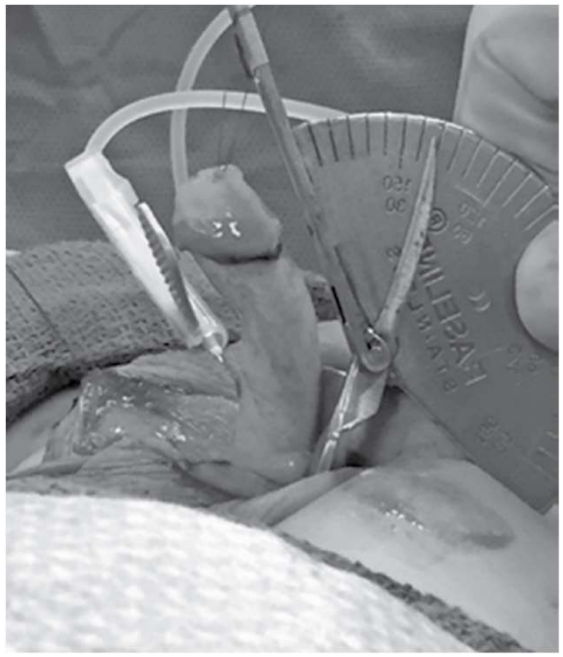
- microphallus, defined as penile length below the third percentile for age. should be 2.5 to 3.5 cm in a full term male

Penile assessment



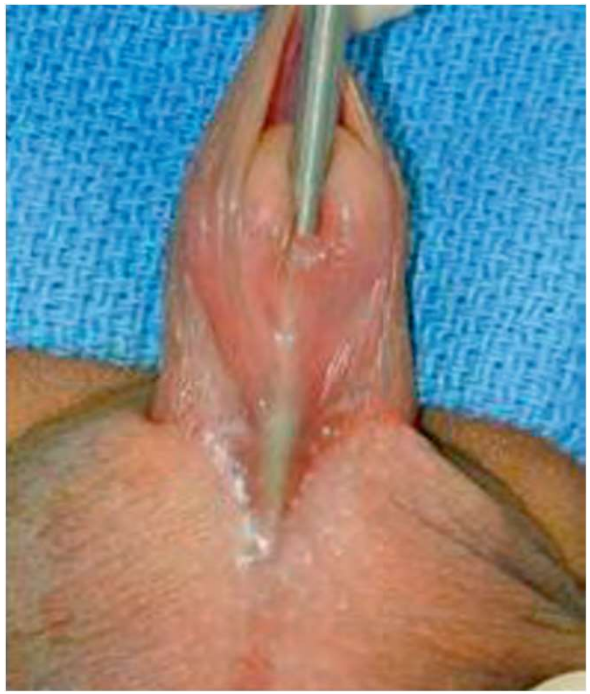
- Measuring glans width with **calipers**

Penile assessment



- Measuring degree of ventral curvature with **goniometer**

Penile assessment

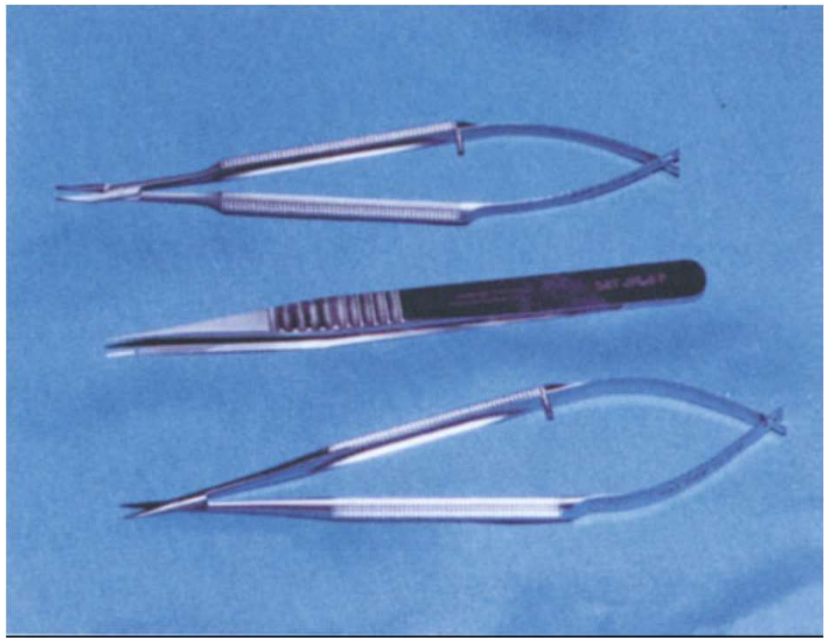


- The “thin” urethra – Dartos and spongiosum deficiency proximal to the meatus on sounding the urethra

Specific materials and instruments

- Loupes
- Marking pen
- Stent – 6 Fr
- Sutures – 7-0 vicryl or PDS (urethra, glans, skin)
  - 5-0 prolene (stay stich & fix stent)
- Instruments - 0.5 Castro-Viejo forceps, needle driver, 69 Beaver scalpel, Tenotomy scissors
- 1:100,000 Noradrenalin or rubber band tourniquet or bipolar diathermy

Specific materials and instruments



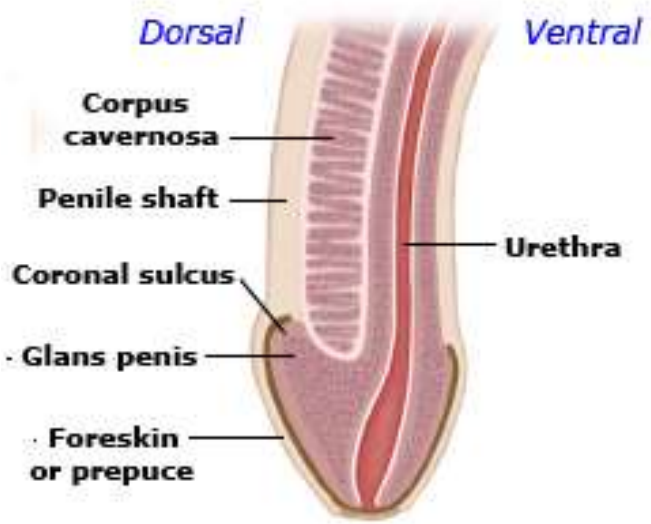
- **Fine instruments** used in hypospadias surgery

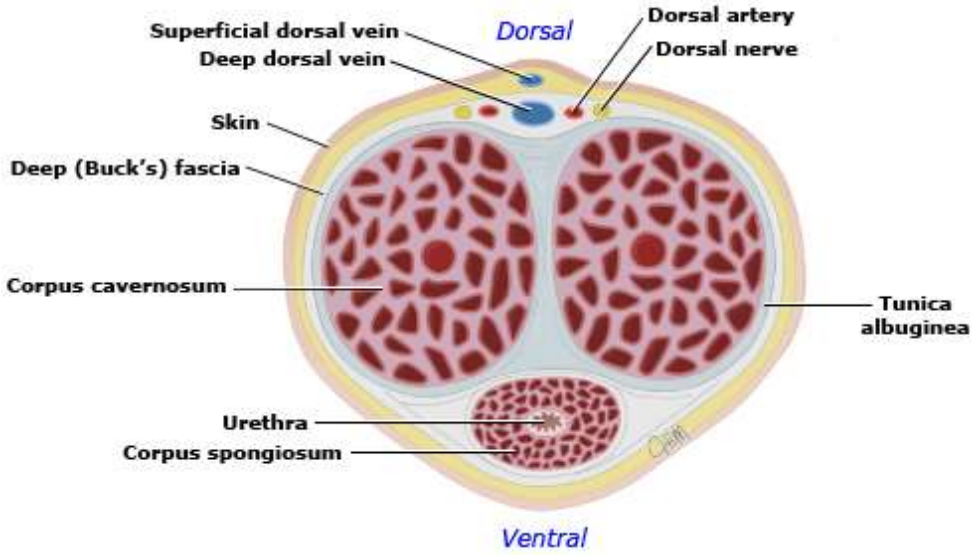
Principles of repair

- Position - Most surgeons prefer to bring patient to the edge and sit
- Optical Magnification - 2-5x
- Traction & stabilization of penis
- Tissue handling – very fine toothed instruments
- Flaps - Avoid tension, well vascularized (don’t make too thin or narrow)
- Tissue hydration - continuously add saline
- Hemostasis while avoiding tissue ischemia – tourniquet time, delicate cautery, avoid tight sutures

3. Surgical techniques

Anatomy of penis





- **neurovascular bundles** lie on buck's fascia in the 11 and 1 o'clock positions No nerve fibers are found at the 12 o'clock position

Goals of repair

- **urination** in standing position (ventral deflection and splaying of stream as a result of meatal location and size- stenosis or megameatus)
- effective **insemination** (painful erection, impaired copulation)
- good **cosmetic** appearance (adolescent psychosexual: hooded prepuce, flat glans, ventral skin deficiency)

Components of repair

3.1. Orthoplasty

3.2. Urethroplasty

3.3. Meatoplasty & Glanslplasty

3.4. *Scrotoplasty

3.5. Skin cover (Circumcision/prepucioplasty)

3.1. correcting ventral curvature

Correcting ventral curvature

- Most men who desire correction of chordee have >25 degree
- >30 degree in 50% of proximal
- Can only be assessed after skin is degloved
- Release ventral dartos, spongiosum from corpora & glans, scrotal attach.
- Artificial erection (heparinized NS into one corpora with 23 guage)

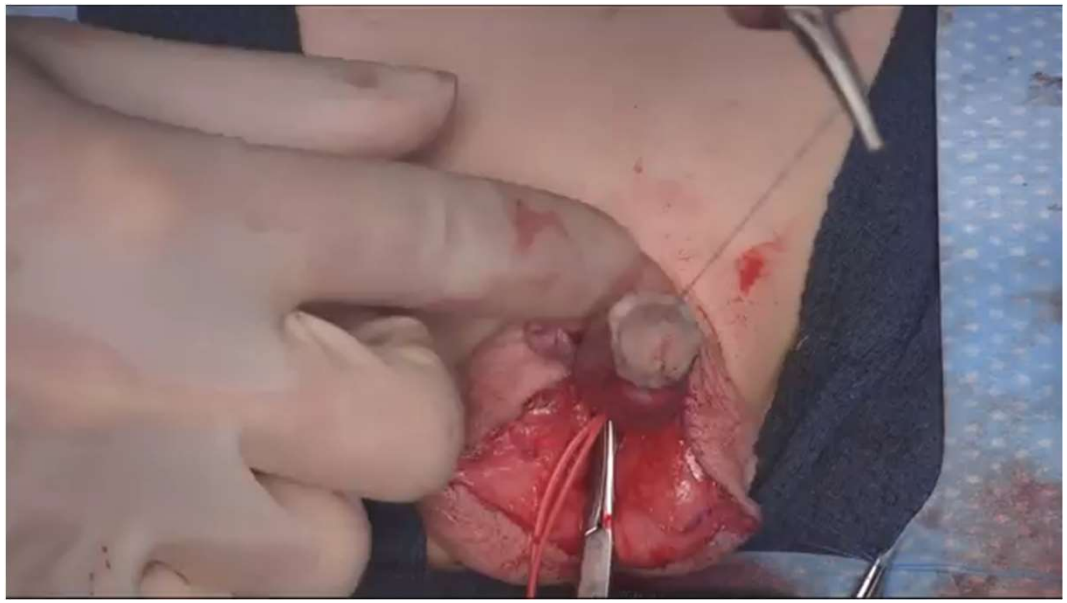
Correcting ventral curvature

- < 30 degree - dorsal plication
  - No need for multiple plication (even if it fails) because less likely to interfere with sexual activity
- >30 degree
  - *urethral plate elevation (off corpora) and reassess*
    - < 30 degree – dorsal plication
    - > 30 degree - ventral corporotomy and reasses
      - <30 degree – dorsal plication
      - > 30 degree - transect urethral plate (at corona and free up to meatus)

Correcting ventral curvature

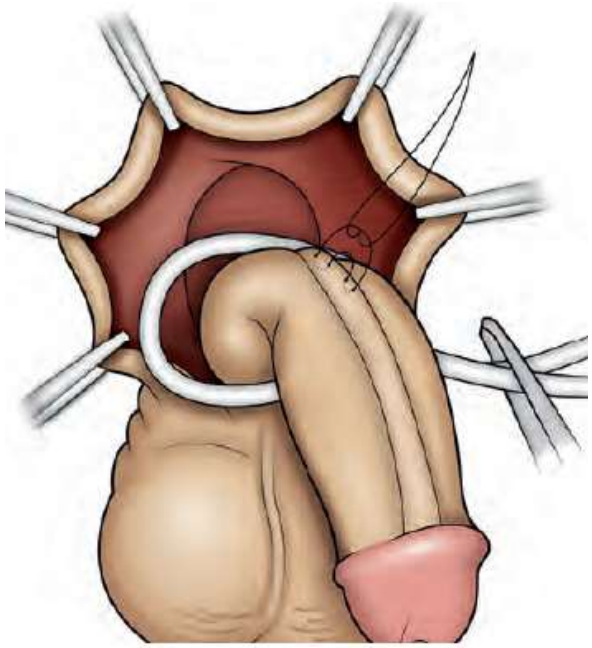
- Degloving – dorsal dissection extends along the buck's fascia to the base of the penis

Correcting ventral curvature



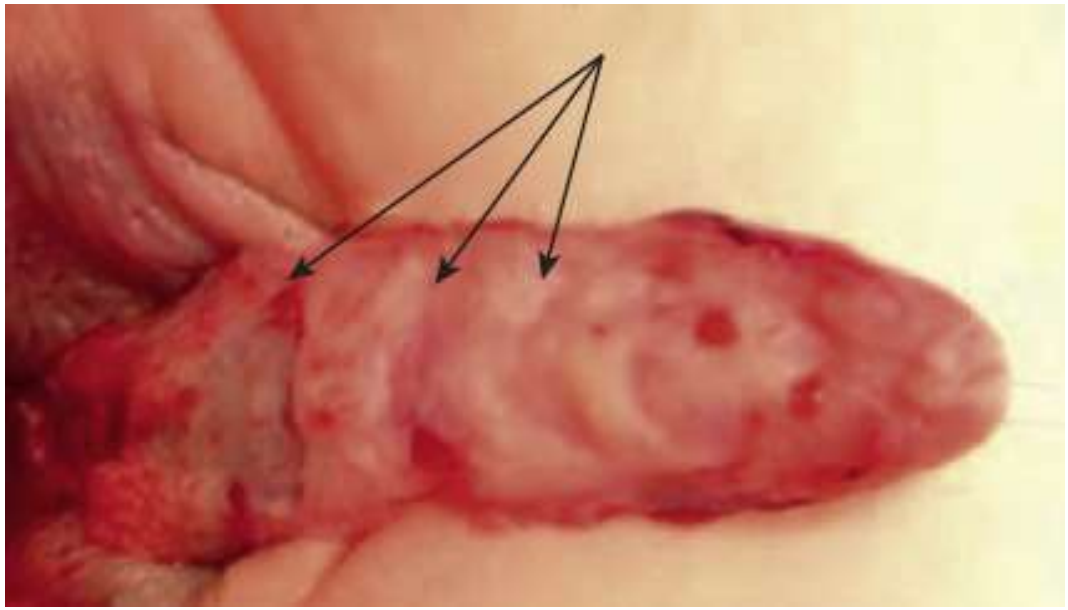
- Artificial erection test with a butterfly cannula into corpora and measuring degree of curvature with goniometer

Correcting ventral curvature



- dorsal plication – incise buck's fascia and use 5-0 or 6-0 prolene at 12 o'clock midline septum of corpora (nerve free zone) burying the note

Correcting ventral curvature



- ventral corporal lengthening - 3 transverse incisions through area of greatest bending or a single incision into tunica albuginea with grafting (but limits urethroplasty options)

3.2. options of urethroplasty

Options of urethroplasty

- Final decision on the location of the meatus is only made after operation has started (after correcting ventral curvature)
- The surgeon must have experience with all options in order to choose optimal technique (no consenus)
- In the past multistage repairs (attaining subcoronal meatus) were popular but with glans-channeling/splitting maneuvers distal tip meatus possible

Options of urethroplasty

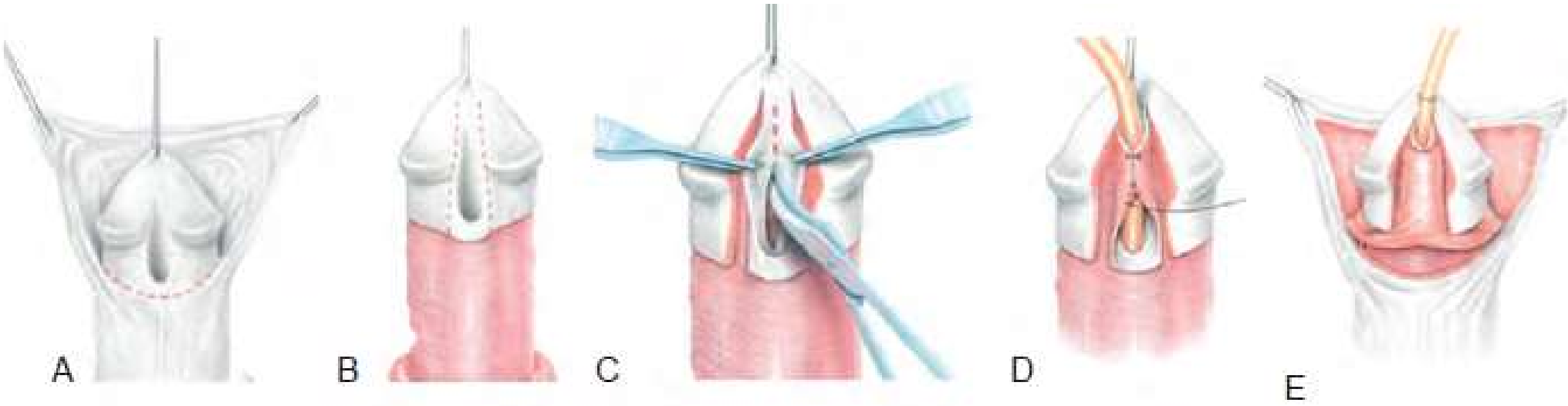
- **Tubularization** (Thiersch-Duplay principle)
  - TIP (Snodgrass modification)
  - GAP
  - Pyramid procedure
- **Flaps** (skin/dartos)
  - Mathieu flap
  - Transverse Onlay flap (Duckett)
  - Transverse Tubularized flap
  - Byars Flap/durham smith (staged)
- **Grafts** (tubularized or staged)
  - Preputal skin
  - Buccal mucosa
  - ?Bladder mucosa

***No urethroplasty** (MAGPI)

Tubularized Incised Plate

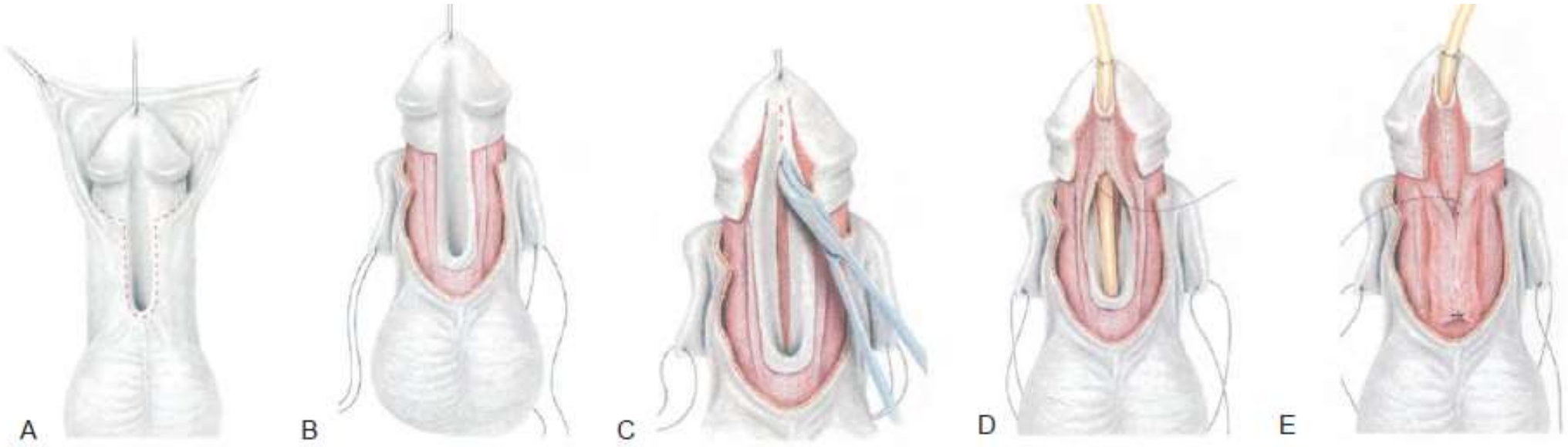
- Snodgrass 1994 – first described TIP
  - Thiersch-Duplay modification
  - Key step is midline incision of the urethral plate
- Snodgrass 2010 – no contraindication to TIP (versatile)
  - Increasingly popular (than flap) because simplify decision making, technique, low complication rate and better cosmetic result
- *All hypospadias can be repaired using either TIP or two stage graft

Tubularized Incised Plate



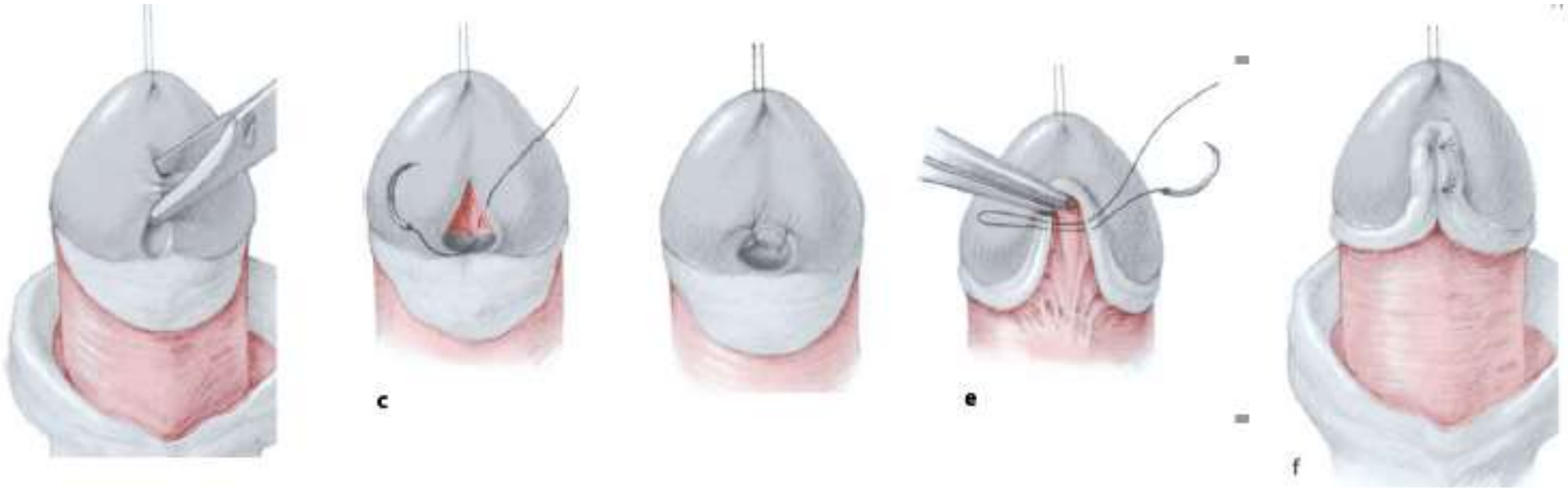
- **TIP for distal hypospadias** – neourethra in 2 layers (subeptihelial) >> dartos flap as barrier layer

Tubularized Incised Plate



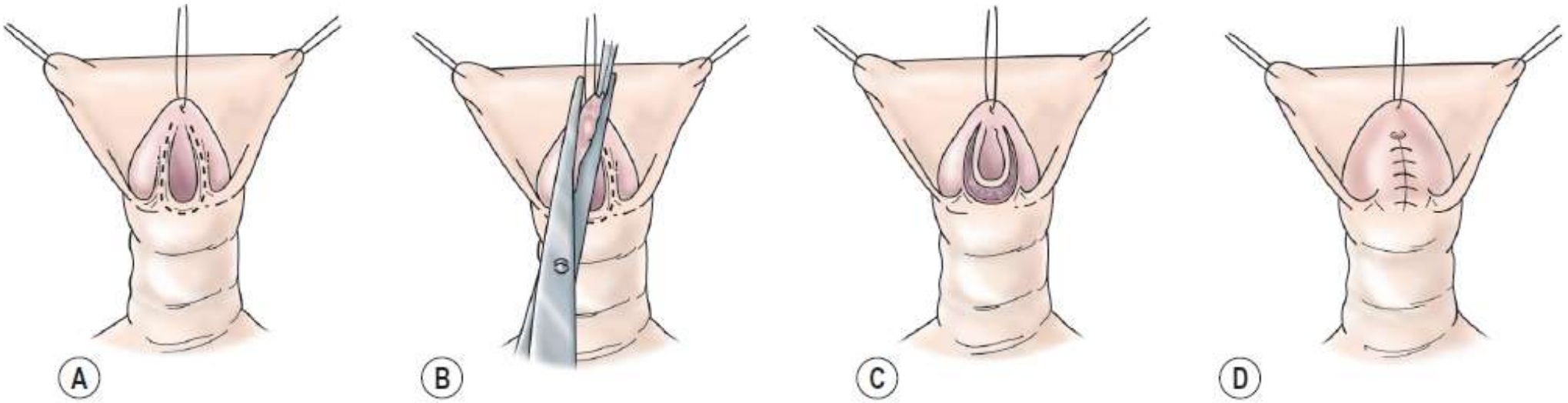
- **TIP for proximal hypospadias** – neourethra in 2 layers >> spongiosum approximated >> enter hemiscrotum for tunica vaginalis as barrier layer

Other repairs: Anterior hypospadias



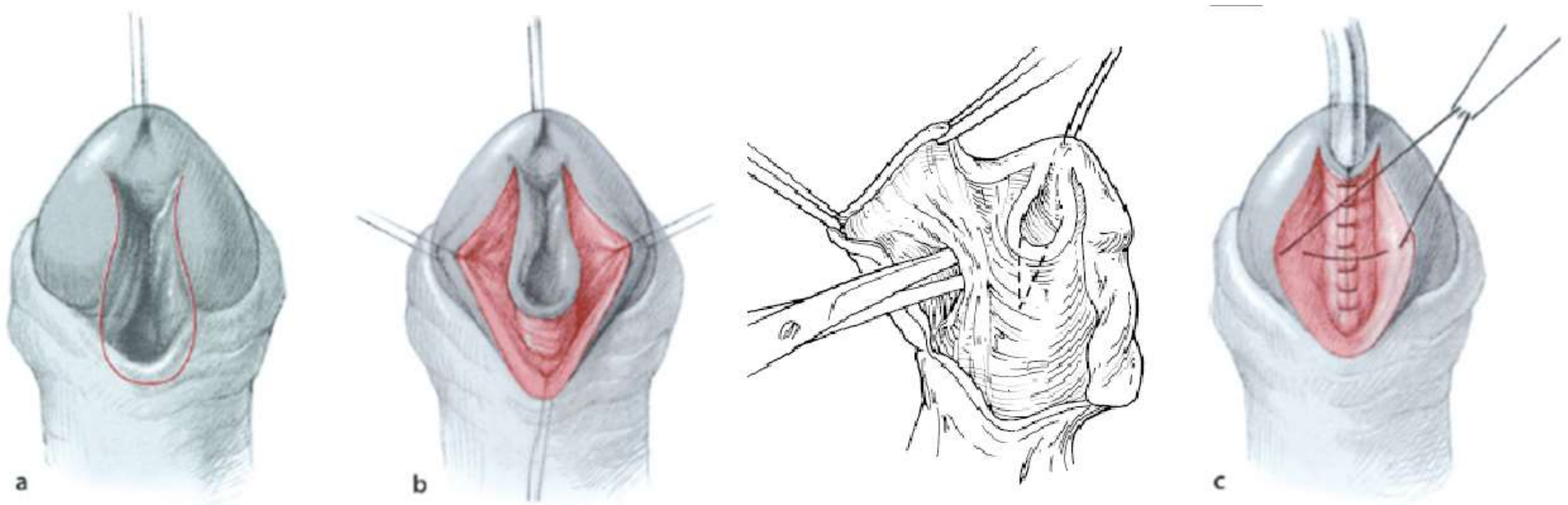
- **Meatal Advancement and glansplasty:** *(stenotic meatus with good mobility of the urethra and a fairly shallow ventral glanular groove)* excision of bridge between meatus and glans>> transverse closure of meatus >> glanuloplasty

Other repairs: Anterior hypospadias



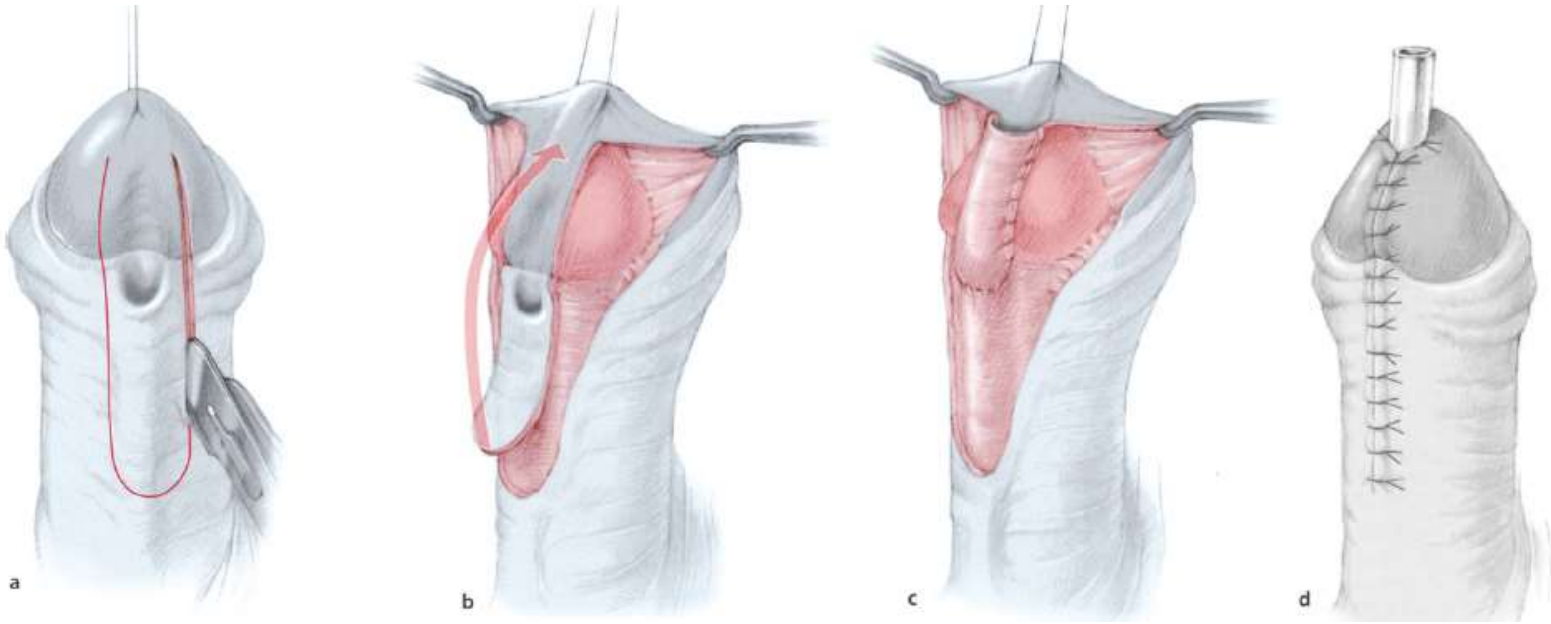
- **Glans approximation procedure=** (*coronal, Wide meatus, very deep groove)* horseshoe shaped incision, glanular urethra is separated from glans and closed in two layers

Other repairs: Anterior hypospadias



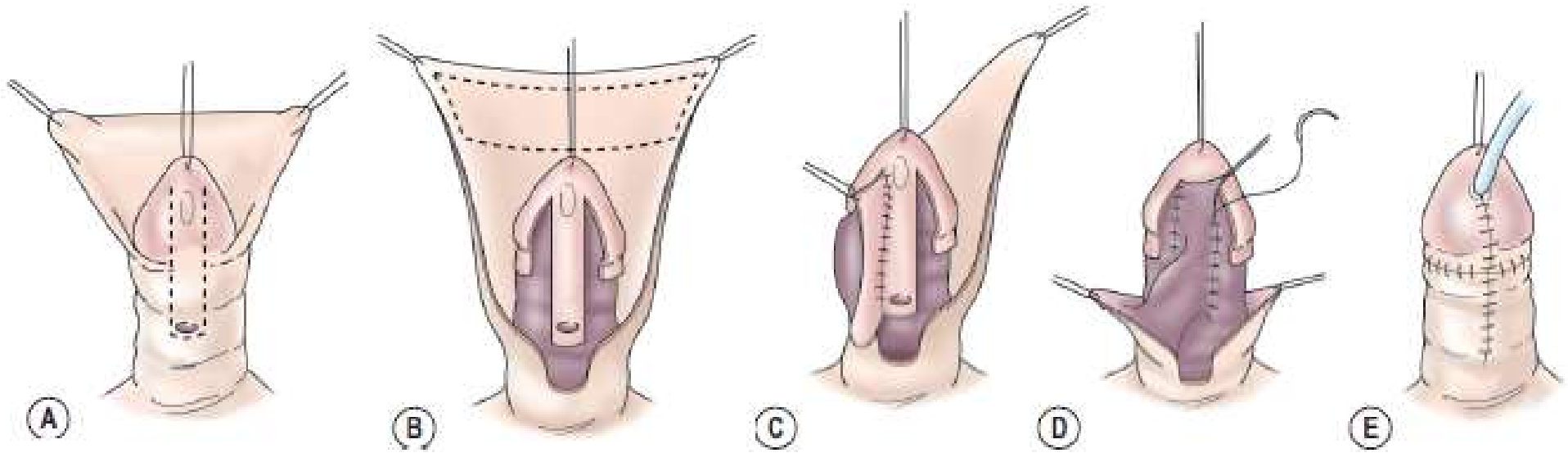
- **Pyramid procedure:** *(for megameatus intact prepuce variant)* tennis racket incision, mobilize urethra proximally until it becomes normal in size, tubularize

Other repairs: Anterior hypospadias



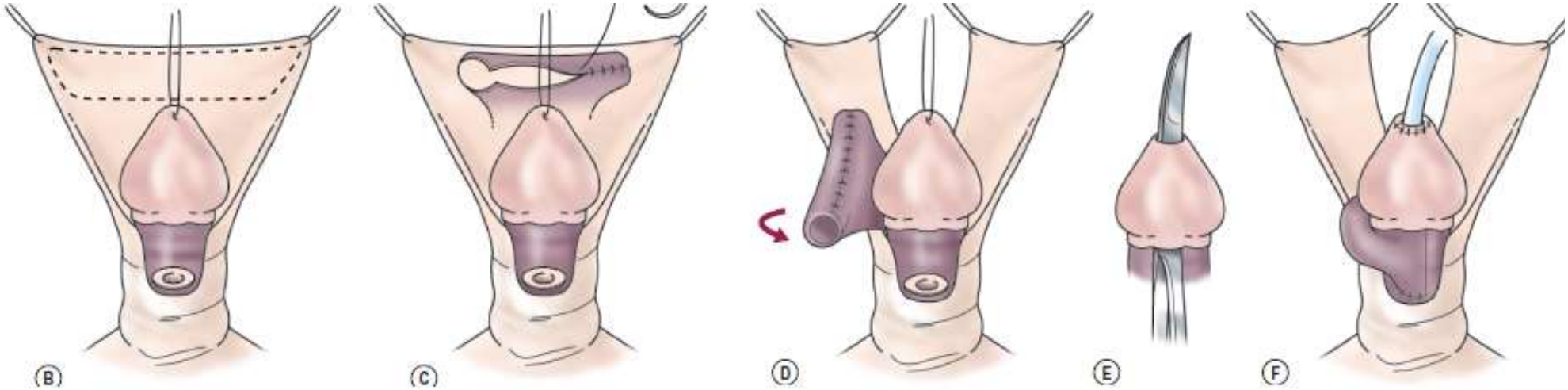
- **Mathieu technique/meatal based flap/flip flap = *(*<u>*Wide meatus, moderate groove, immobile tissue, proximal well vascularized, thick skin*</u>***)*** raising meatal based flap proximal to meatus and anastomosing to sides of the urethral plate

Other repairs: Middle hypospadias



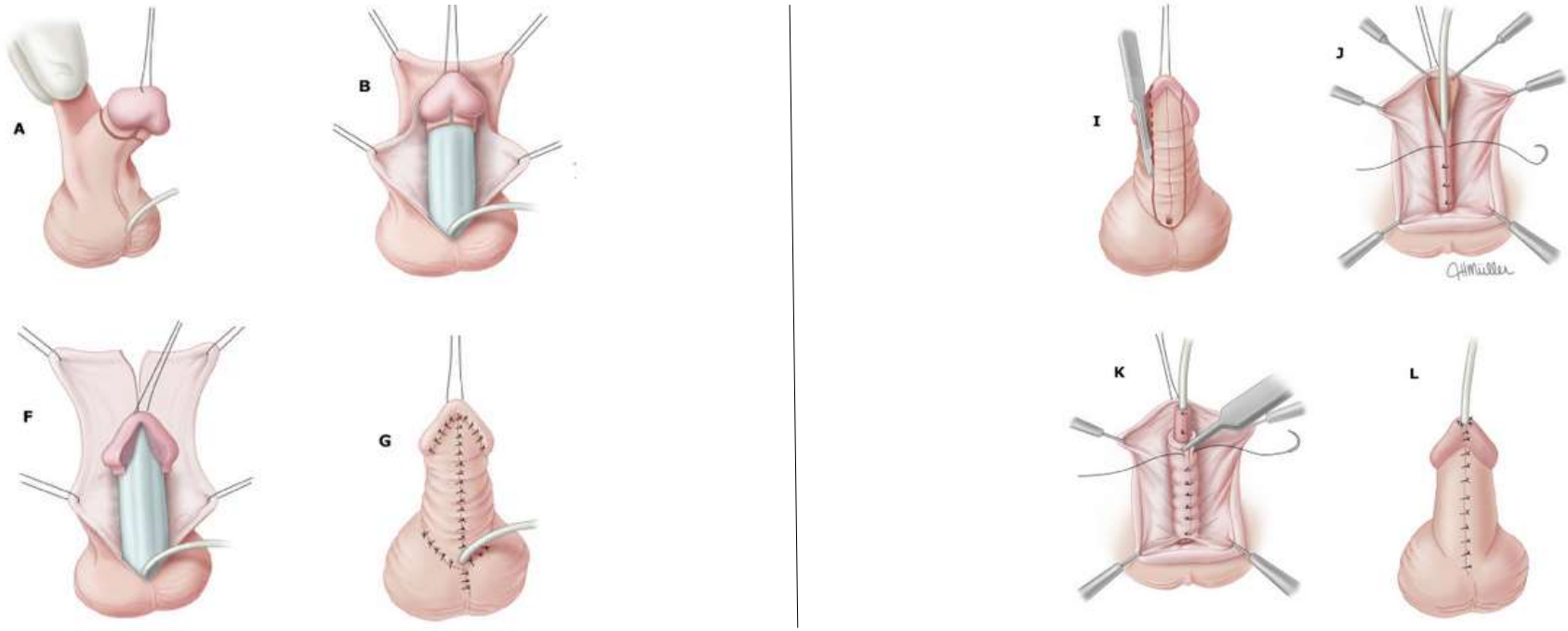
- **Transverse Onlay preputal flap** – *(middle hypospadias with mild chordee)*
  inner prepuce flap transposed and anastomosed to sides of the urethral plate

Other repairs: proximal hypospadias



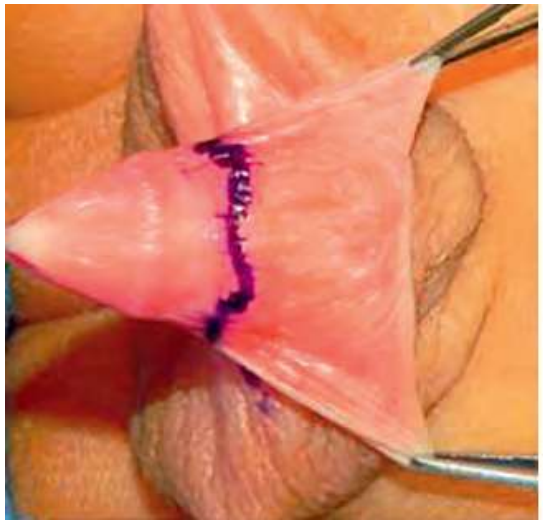
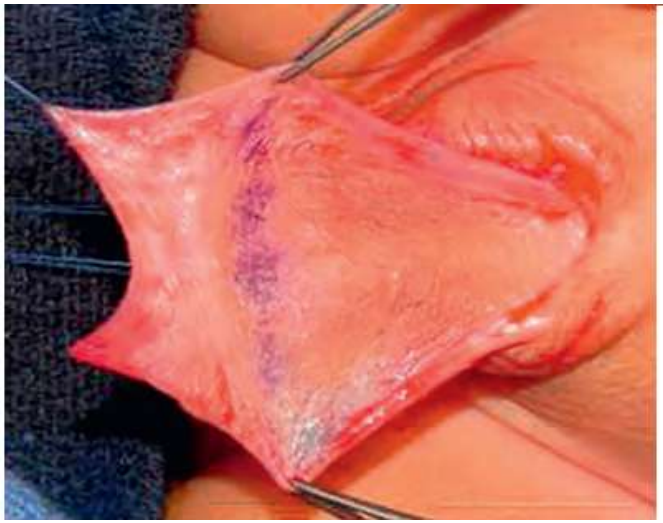
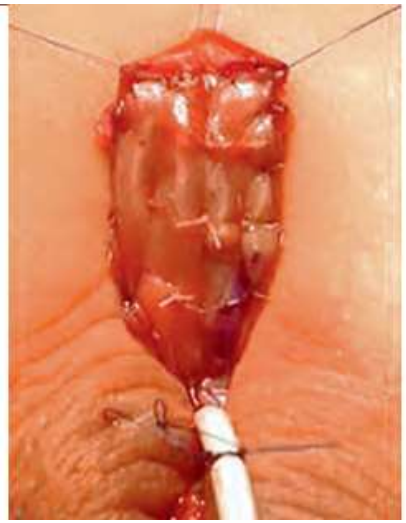
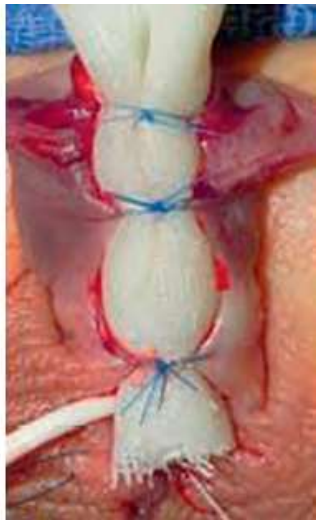
- **Transverse tubularized preputial flap** –Tubularization of inner prepuce and transposition of the flap to anastomose to the native urethra

Other repairs: proximal hypospadias



- **Staged repair (Byars and durham smith)**- *(Very severe skin deficency or very severe chordee requiring tunica vaginalis)* Stage one (preputal flap) and two (tubularization)
  **6 months in between procedures to ensure complete wound healing*

Other repairs: proximal hypospadias

- **Staged repair (preputal graft)**- Stage one (preputal graft harvest and quilting)

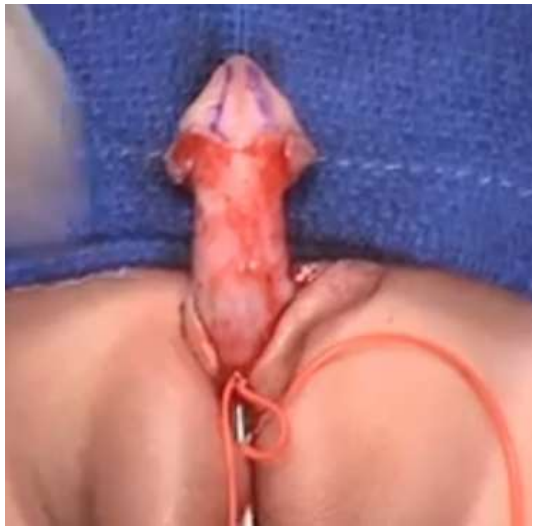
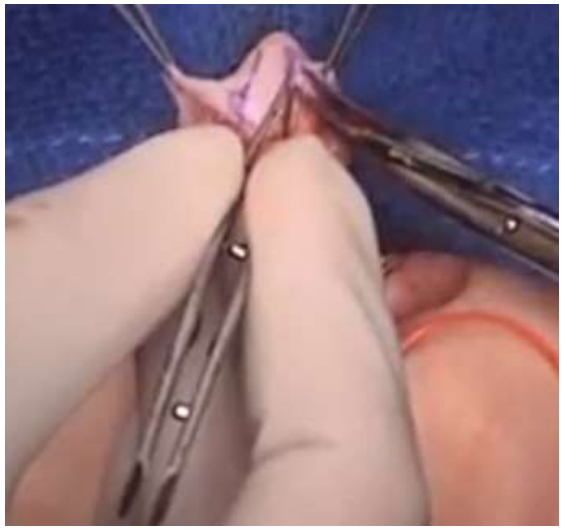
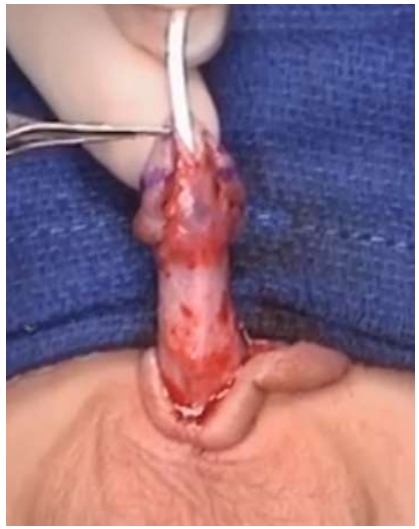
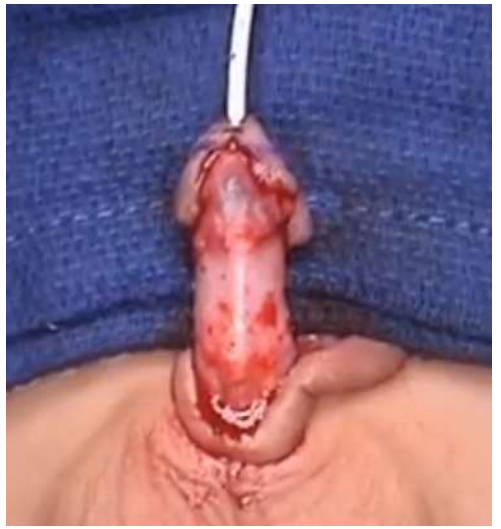
Flap vs graft in proximal hypospadias

- Snodgrass doesn't recommend staged flap (Byars) due to complications *(diverticula or stricture that resulted when a less wide skin strip was tubularized to prevent a diverticulum)*
- No RCT comparing Tubularized flaps and staged graft
  - Tubularized flap – one surgery, ? Vascularity is assured (theoretically)
    - less cosmetic (glans not cylindrical and dehiscence)
  - Staged grafts – less meatal stenosis and stricture reported

    (complications associated with devascularization)

3.3. Glansplasty

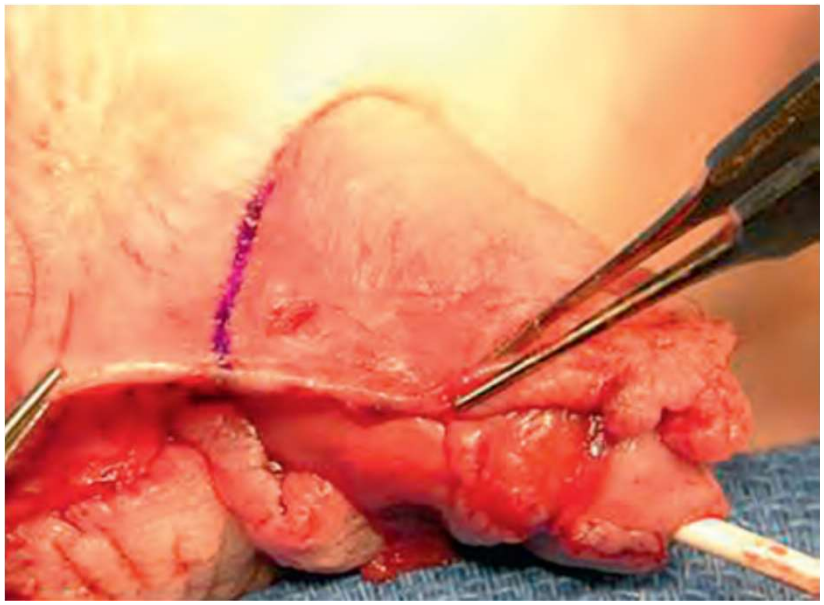
Glansplasty

- **Glanuloplasty**: Creation of a symmetric, conically shaped glans by approximating the lateral glanular tissue (well developed glans wings) in the midline ventrally over a meatoplasty

3.4. scrotoplasty

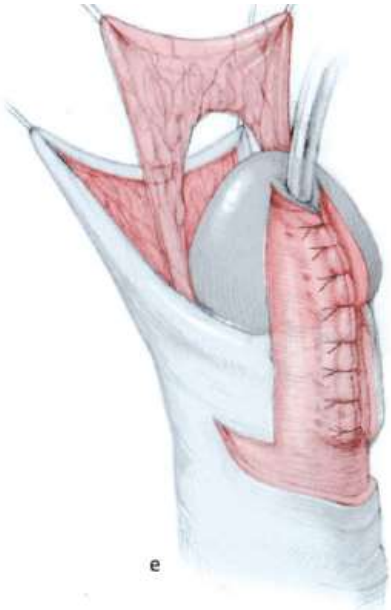
Scrotoplasty

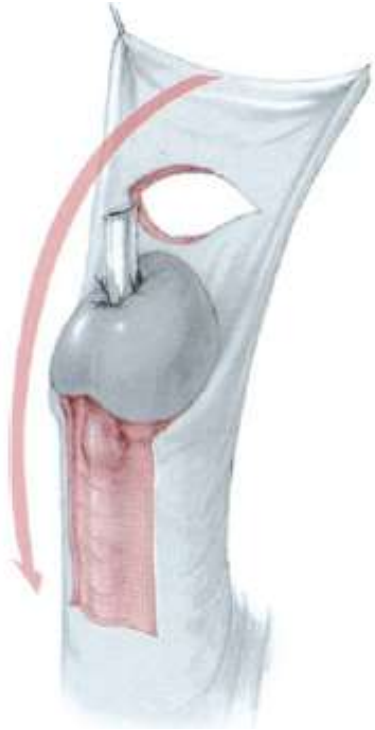


- **Scrotoplasty without scrotal flaps** - incise penoscrotal junction ventrally extending to 3 & 9 o'clock>> scrotum near these points is sutured to the corpora on either side of the true penoscrotal junction

3.5. skin cover

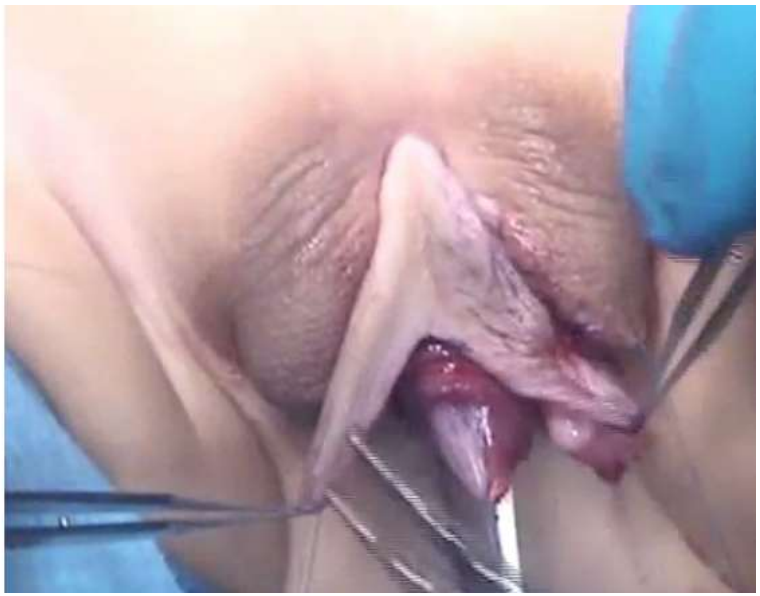
Skin cover





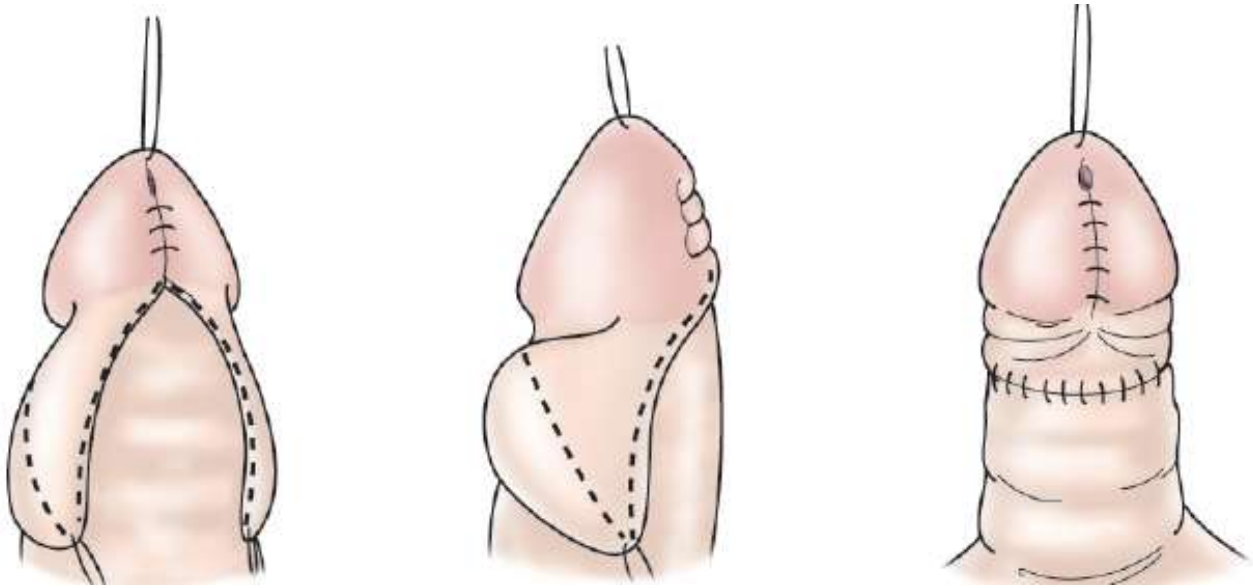
- **Buttonhole of dorsal skin** and draping over distal part of ventral penis: transfers well vascularized skin but is not cosmetically appealing

Skin cover



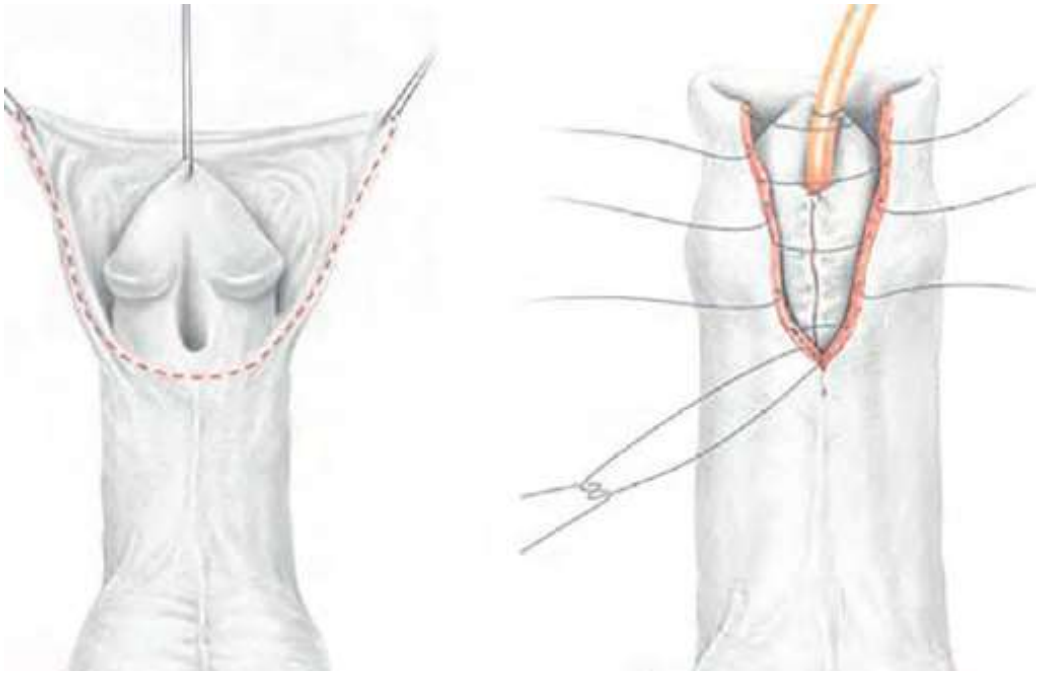
- **Splitting dorsal skin** in the midline longitudinally and advancing on either side to meet in the ventral midline: simulates median raphe and preputal collar

Skin cover



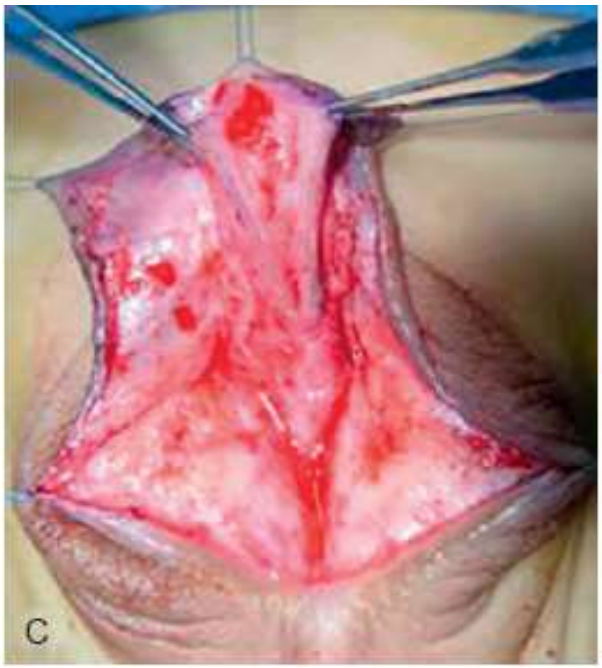
- **advance Lateral preputial wings (**At the time of glansplasty**)** to ventral midline to give circumferential preputial collar

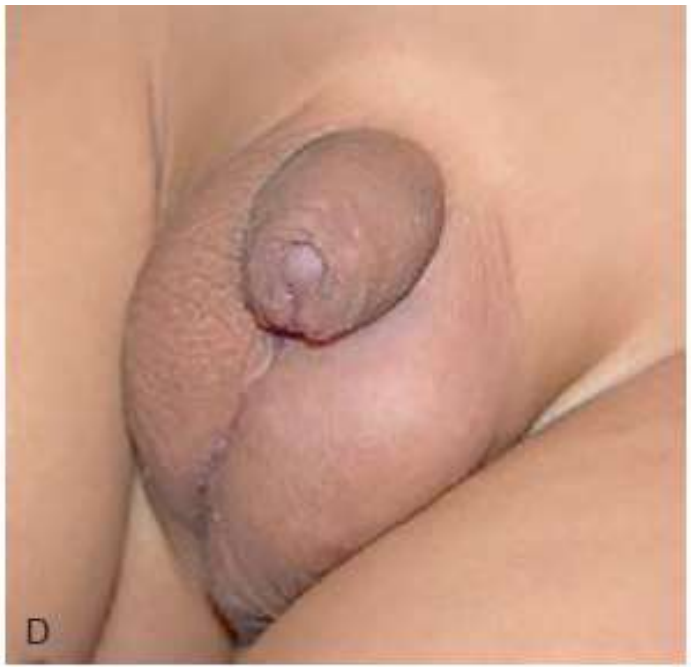
Skin cover



- **Prepucioplasty distal hypospadias:** V-shaped incision from the corners of the dorsal prepuce extending 2mm below the meatus. Penis not degloved

Skin cover





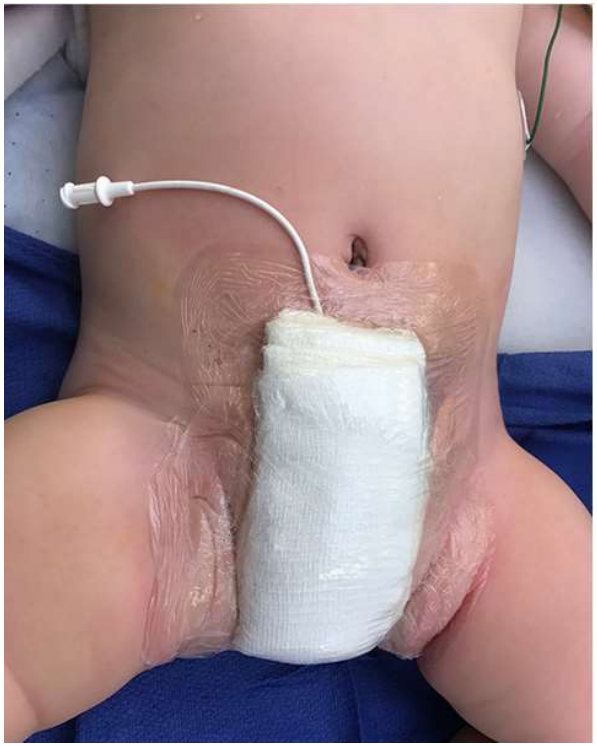
- **Prepucioplasty proximal hypospadias:** ventral exposure gained without degloving the penis.

4. Postop considerations

Early postop:

- Urinary diversion - catheter 5-14d depending on complexity .
  - * ?Suprapubic for complex reoperations & free grafts
- Dressing - enough pressure to help with hemostasis and edema without compromising vascularity
- Antibiotics – oral antibiotics (cotrimoxazole, nitrofurantoin) if urine diverted (? Catheters that open drainage in diaper)
- Analgesia – alternating ibuprofen and acetaminophen
- Antispasmosidic - oxybutynin 0.2mg/kg (max 5mg) bid for > 3years

Early postop



- **Dressing** after hypospadias repair

Early postop

- **Double diaper with catheter** after hypospadias repair

Follow up:

- Timing – 6 weeks, 1 year, after toilet training, at adolescence
  - 80% complications are found within 1 year
  - Indefinite duration of follow up after a complication encountered

- Calibration – for questionable voiding and small appearing meatus
  - ?10fr after 8th mo postop for pre-toilet trained
- uroflowmetry – significance of low flow rate in asymptomatic patients is unkown

5. Complications

Complication rate

- Distal hypospadias 1-5%
- Proximal hypospadias 10-50%

List of complications

- ventral curvature Persistence
- Neourethra
  - Fistula
  - Stricture
  - diverticula
- Glans dehiscence
- Meatal stenosis
- Skin issues
- *Balanitis xerotica obliterans*

Risk factors for complications (TIP)

- glans width <14mm = extended glans wing dissection
- proximal meatus = ? Centralize cases (since rare)
- Reoperations = consider change in technique

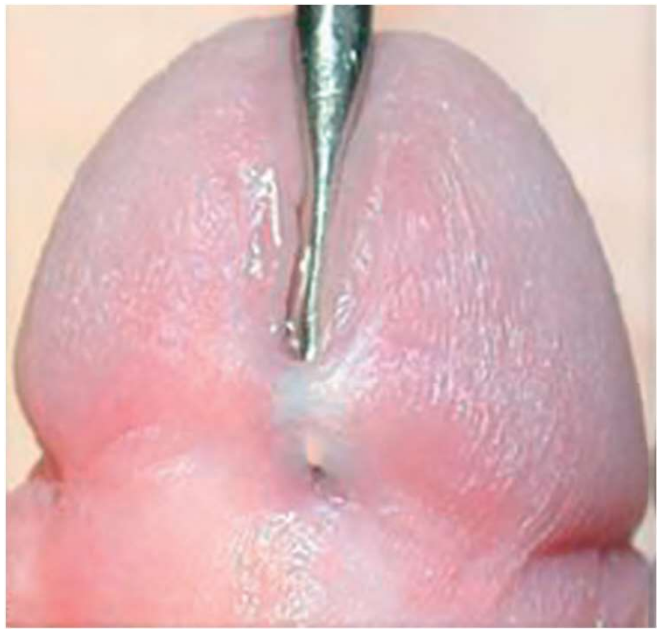
Urethrocutanteous fistulas

- Mean time of occurrence is 6 mo
- Prevention by Snodgrass modification on proximal TIP (decreased rate from 33% to 0%)
- Recurrence after repair is 6-29% (8% snodgrass).
- ? No difference weather or not urinary diversion is used
- Need to correct chordee with repair (chordee is a reason for recurrence)

Urethrocutanteous fistulas repair

- *Calibrate to 8 Fr stent*
- *Inject saline to confirm fistula sites*
- *Excision of fistula tract*
- *Closure of urethral opening (subepithelial)*
- *Check weather its a water tight closure by injecting saline*
- *Flap coverage of the defect (ventral dartos)*

Urethrocutanteous fistulas repair



- **Coronal fistula with only band of skin holding glans together** = decision of **UCF repair** vs **reoperation** for coronal fistulas depends on the degree of glans dehisence

Glans dehiscence

- **Complete separation of glans wings with or without a bridge of skin**
- Underreported (5% Snodgrass, ~20% in proximal)
- Cosmetic + functional (deviated/spraying stream)
- Prevention by extended glans wing dissection (completely dissect off corpora 3-9 o'clock)
- Repair by **Redo surgery** with extended glans dissection

Meatal stenosis

- ? Meatal size < 8 fr in a symptomatic child
- Diagnosis not standardized, so rates vary ~3%
- Prevention by
  - limiting incision to urethral plate (avoid above mid glans)
  - tubularization beginning 3 mm from distal end (oval opening)
  - Independent glans wings approximation (not suturing to neourethra)
- Repair by **incising neourethra dorsally**

Urethral stricture

- A rare complication, especially with TIP (highest is 9% in TVPF)
- **Prevention** – avoid dissection of plate from the corpora to correct chordee while preserving urethral plate (17% had strictures vs 0% in other proximal TIP)
- **DIVU** for stricture **<1cm** following **tubularization** or **onlay flap**

  (66% success)
- For all other strictures and for recurrent stricture… **reoperation**
- **Stricture excision and urethral mobilization has not been reported*

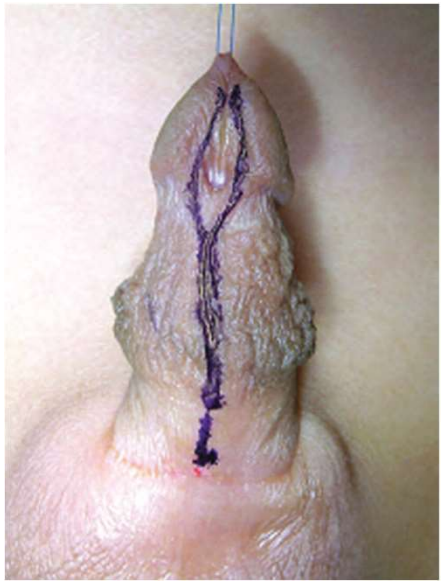
Hypospadias “cripples”

- Recurrent multiple complications resulting in a combination of severe complications– extensive urethral stricture/fibrosis, fistulas, stricture, persistent curvature, diverticula
- Reoperations – if tissue available use vascularized flaps or staged. If graft used buccal mucosa is best

Reoperations: repair options

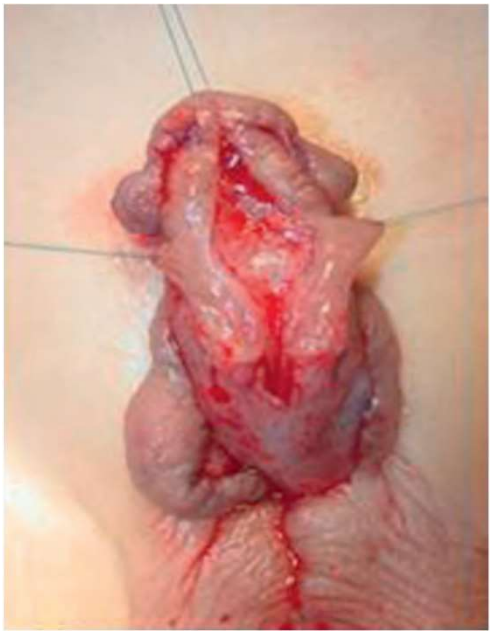
- Urethral plate maintained, no gross scar => TIP
- *? Sufficient skin, no scar => TVPF*
- Urethral Plate excised/long stricture, no scar => inlay oral graft
- Urethral plate (skin substitute) is grossly scarred, severe chordee, hair in urethra => 2 stage (oral graft)

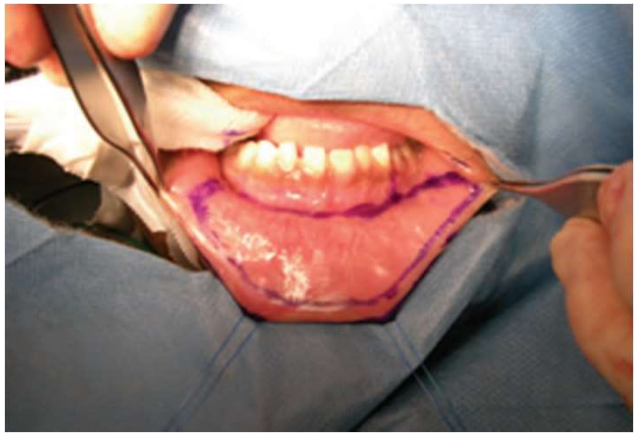
TIP

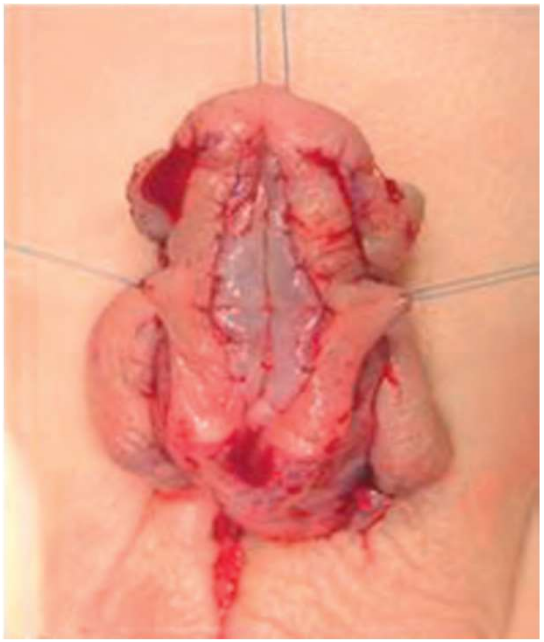


- **Redo-TIP incision**: good exposure for glansplasty, urethroplasty and ventral dartos barrier flap without degloving (unless there is chordee)

Dorsal inlay graft







- **Dorsal inlay graft**: the skin strip substituting for the urethral plate is incised dorsally and defect is grafted with oral mucosa (upper or lower lip)

6. Our experience

ORIGINAL ARTICLE

Hypospadias Repair in Ethiopia: A Five Year Review

Tihitena Negussie[1], Samuel Negash[1], TeamirNegussie[1], Hanna Getachew[1], Belachew Dejene[1], Amezene Tadesse[1], Miliard Derbew[1]

- Retrospective review 2009-2014
- 246 hypospadias repairs
  - 202 boys included
  - 44 (18%) missing charts

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Tihitena Negussie[1], Samuel Negash[1], TeamirNegussie[1], Hanna Getachew[1], Belachew Dejene[1], Amezene Tadesse[1], Miliard Derbew[1]

- Older Age at repair (>18 months) in 80%
- Severe hypospadias (penoscrotal, scrotal perineal) in 32%
- Severe chordee in 30%

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Table 2: Procedure performed for each type of hypospadias

	Hypospadias Type				
Procedure type	**Anterior**	**middle**	**posterior**	**Total**	**P value**
MAGPI	12 (11.4%)	0 (0%)	0 (0%)	12 (5.9%)	
Mathiewi's	9 (8.6%)	0 (0%)	0 (0%)	9 (4.5%)	
Thiersch-Duplay	7 (6.7%)	3 (9.1%)	0 (0%)	10 (5%)	0.00
TIP	76(72.4%)	16 (48.5%)	3(4.7%)	95 (47%)	
Transverse preputal island flap	0 (0.0%)	11 (33.3%)	41(64.1%)	52 (25.7%)	
Onlay island flap	1 (1.0%)	2 (6.1%)	2 (3.1%)	5 (2.5%)	
2 staged	0 (0.0%)	1 (3.0%)	18 (28.1%)	19 (9.4%)	

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- Major complications (requiring surgical intervention) 44%
- Significant association of complication with
  - Older Age at repair
  - Severe hypospadias and chordee
  - Mathieu and two stage repair

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- UCF (31%) significant associations
  - 49% of severe hypospadias (penoscrotal, scrotal, perineal)
  - 18 % of distal hypospadias (glanular, coronal) developed UCF
  - 77% of mathieu and 68% of two stage developed UCF
  - 40% of TVPF, 30% Thiersch-Duplay, 20% of onlay, 19% of TIP

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- Meatal stenosis (7%) significant associations
  - 17.5% of distal hypospadias (glanular, coronal)
- Glans breakdown (7%) significant associations
  - 14% of severe hypospadias (penoscrotal, scrotal, perineal)
  - 20% of Onlay and 21% of two stage
  - 11% of Mathieu, 10 % Thiersch-Duplay, 8% TPVF, 4% TIP

References

- **Campbell-walsh urology** 11th edition, 2016
  - Warren T. Snodgrass and Nicol Bush: Hypospadias
- ***Ashcraft's pediatric surgery 6th edition, 2014***
  - Patrick J. Murphy: Hypospadias
- ***UpToDate:*** Laurence S Baskin, hypospadias. 2017
- *Thitena Negussie et al.* ***Hypospadias repair in Ethiopia: A 5 year review.*** *Ethiop J Sci. 2018. 28 (6)*