Hypospadias Repair in the '90s

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The approach to hypospadias surgery has evolved over the past 10 years because of a better understanding of the anatomical features of this congenital anomaly. The identification and use of the "urethral plate" as an anatomical entity has considerably simplified this surgery which now involves a small number of procedures using the same principles, allowing a single-stage repair in all cases.

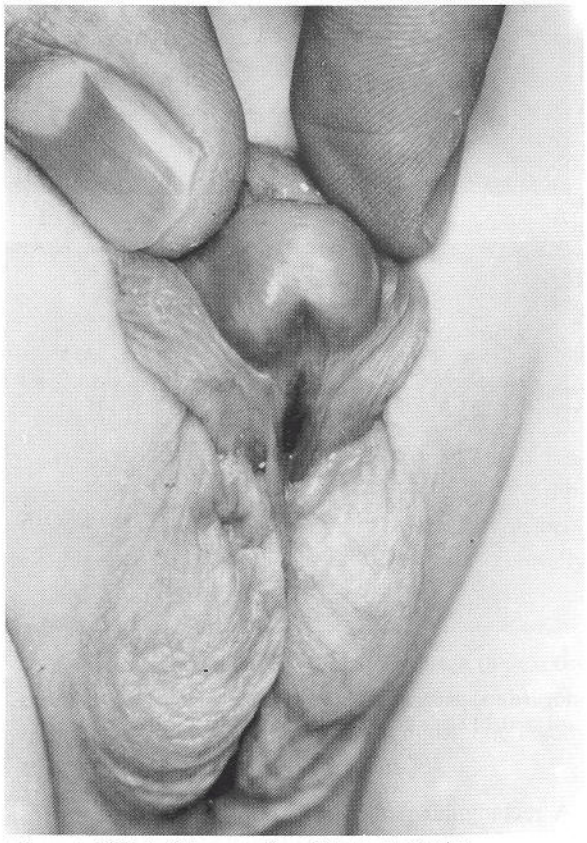


Figure 1. Mid-shaft hypospadias with severe chordee.

Hypospadias is classically defined as an association of three anatomical anomalies of the penis (Fig. 1): **1)** an abnormal ventral opening of the urethral meatus which can be located at any position on the ventral aspect of the penis*; **2)** an abnormal ventral curvature of the penis (chordee); **3)** an abnormal distribution of the foreskin around the glans with the ventrally deficient hooded foreskin.

Looking more carefully at these anomalies, hypospadias may be defined as an atresia of the ventral radius of the penis: the skin shaft is often poorly represented on the ventral aspect of the penis and sometimes very adherent to the underlying urethra; the ventral height of the glans is poor and the glans itself is wide opened; the corpus spongiosum is atretic and represents one of major factors of the penile chordee; the frenular artery is constantly missing even when the foreskin is intact and in some rare cases the ventral aspects of the corpora cavernosum are also atretic.

The aetiology of the poor development of the ventral tissues of the penis is unknown: impaired hormonal secretions or receptivity, genetical disorders or vascular anomalies have been suggested but never confirmed, though it is true that this anomaly has a higher incidence in the same family.

Modern principles of hypospadias repair

According to the anatomical features described above, three main steps characterize hypospadias surgery: the first one is the correction of the penile chordee; the second is the reconstruction of the missing urethra (urethroplasty); the third is the fashioning of the urethral meatus (meatoplasty), the ventral aspect of the glans (glanuloplasty), the mucosal collar and the skin cover of the penile shaft.

2.1 The first step is to correct the penile chordee, which is related to 4 possible factors: **1)** the abnormal distribution of the skin around the penile

* The urethral meatus may look narrow though exceptionally stenotic. The chordee and the hooded foreksin are common but not constant.

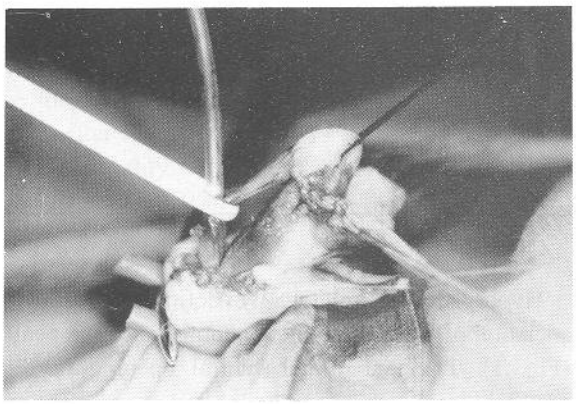


Figure 2. Complete correction of the chordee by lifting the urethral plate off the ventral surface of the corpora cavernosum. After untethering, the urethral plate remains attached by its two extremities, proximally to the urethra, distally to the glans groove.

shaft and the tethering of the skin onto the underlying layers; **2)** the tethering of the urethral plate onto the ventral surface of the corpora cavernosum; **3)** the atretic corpus spongiosum which extends in a fan shape from the ectopic meatus to the glans cap; **4)** in rare cases, an atresia of the ventral aspect of the corpora cavernosum can be responsible for some residual chordee.

Therefore, the correction of the chordee, when it exits, implies **1)** the degloving of the penis, **2)** the dissection of the urethral plate which is carefully lifted off the ventral surface of the corpora cavernosum. It is remarkable to see the lengthening and the narrowing of the urethral plate as soon as it is freed from the corpora, even in posterior hypospadias. The 2 lateral wings of the glans are also dissected extensively at this stage, **3)** the excision of the atretic and fibrous corpus spongiosum distally to the ectopic meatus, **4)** in rare cases (less than 5%), the penis remains bent and a dorsal plication of the tunica albuginea of the corpora (Nesbit) [25] can be performed or a derotation of the corpora which is a more complex procedure [17].

2.2 When penile straightening is achieved and checked by an artificial erection test [16], it is then possible to perform an urethroplasty using the urethral plate which remains attached proximally to the urethra and distally to the glans cap (Fig. 2). There are 2 options to reconstruct the missing urethra:
1) either the urethral plate is wide enough to be rolled into a tube (Thiersch, Duplay) [10,27] (Fig. 3);
2) or the urethral plate is too narrow to be rolled and is then used as a mooring plate for the urethroplasty.

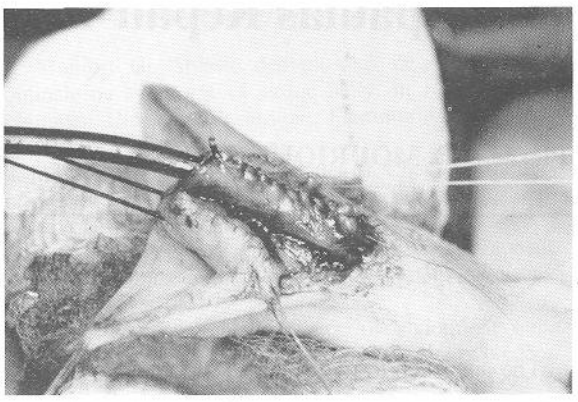
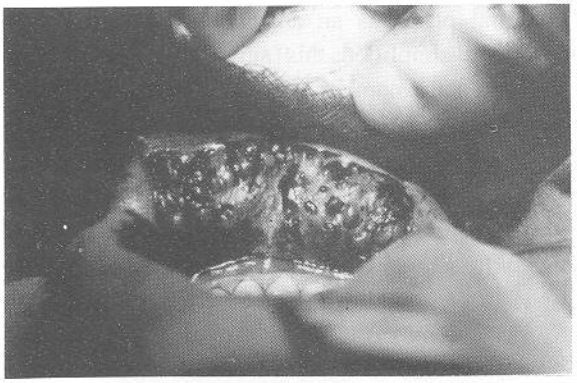


Figure 3. YELSNAR urethroplasty (same patient as Figure 2): the tubularizaton of the urethral plate is achieved with a running suture of 7/0 PDS.



a

b

Figure 4 a) Inner aspect of the inferior lip after harvesting a buccal graft, **b)** Same patient, two days later.

A rectangular pediculized flap of preputial mucosa or a rectangular free graft of buccal mucosa or bladder mucosa (Fig. 4) are the main materials used for creating a new conduit. This rectangle of tissue (whatever it is) is sutured to the two edges of the urethral plate creating a tube without doing a cir-

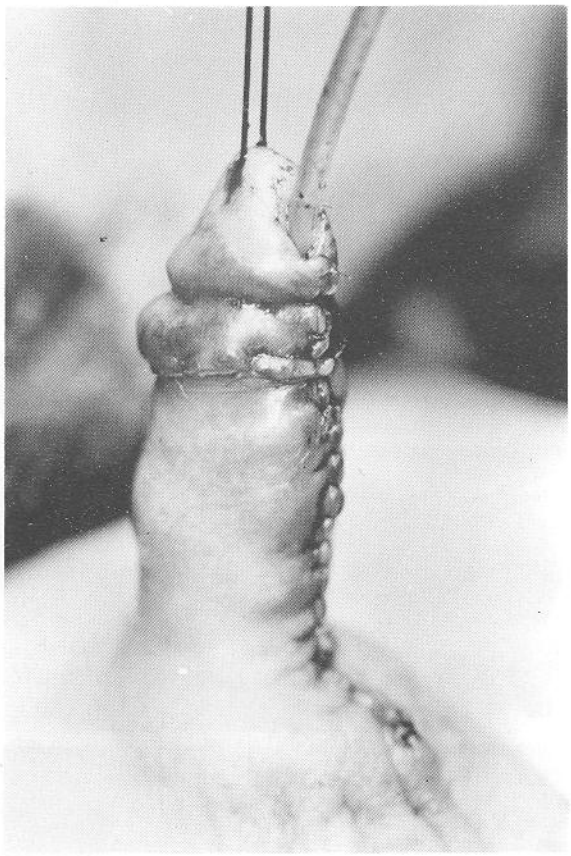


Figure 5. Meatoplasty, glanuloplasty, Firlit mucosal collar and sleeve skin cover represent the third step of hypospadias reconstruction.

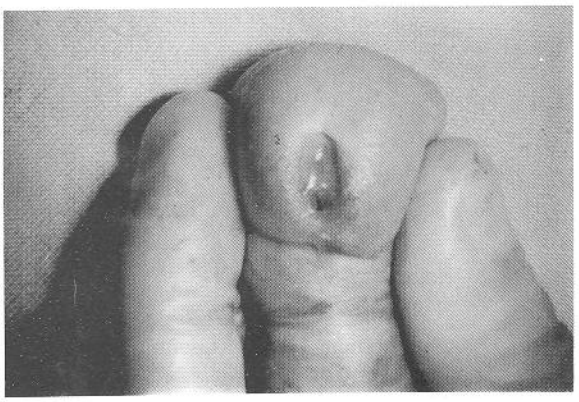


Figure 6. Glanular hypospadias (see Fig. 8 a,b,c,d: same patient).

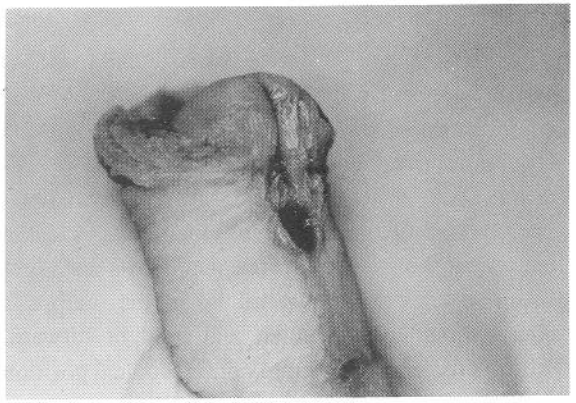


Figure 7. Anterior hypospadias without chordee.

cular anastomosis: This is the Onlay urethroplasty [11], the roof of the neourethra being the urethral plate and the floor of the neourethra being the preputial mucosa or bladder or buccal mucosa.

2.3 When the urethroplasty is completed, the meatoplasty and glanuloplasty are performed by rapproaching the 2 wings of the glans over the neourethra. A mucosal collar is brought ventrally around the corona using the excess of dorsal preputial mucosa [14] (Fig. 5).

2.4 The skin cover (Sleeve cover) uses the excess of dorsal skin which is progressively brought ventrally. The Sleeve cover gives better cosmetic results than the traditional Byars procedure [5].

A practical classification of hypospadias

3.1 The glanular hypospadias (Fig. 6): The meatus is distal to the corona and there is usually no chordee.

The most common procedure used is the MAGPI (Meatoplasty Advancement and GlanuloPlasty Incorporated) [7]. Other ones roll the distal urethral plate (GAP, GRAP, Duffy etc.), or use a flap of skin shaft (Mathieu) [18].

3.2 The anterior hypospadias without chordee (Fig. 7) (or with a minor degree of chordee): The meatus is at any position between corona and midshaft. When the urethral plate is wide enough, a Thiersch-Duplay procedure [10,27] can be used, if not a Mathieu urethroplasty is recommended.

3.3 All other hypospadias with chordee (Fig. 1) need a 3 step approach as described above (Untethering and preservation of the urethral plate [23]; Duplay or Onlay urethroplasty; Meatoplasty, glanuloplasty and skin cover).

3.4 Cripple hypospadias usually require a complete revision of the penis. The urethral plate even scarred can be preserved in many cases and the urethroplasty often uses an onlay buccal graft.

Current techniques

Pediatric Urologists only use single-stage procedures in hypospadias. Multi-stage procedures are not discussed here.

4.1 Glanular hypospadias. Many techniques have been described. Amazingly it is often more difficult to operate on these distal hypospadias (so-called "minor") than the posterior ones (so-called "major").

i- MAGPI (Fig. 8)

Meatal Advancement and Glanuloplasty Incorporated [7] is a popular procedure described by Duckett in 1981. It is actually not an advancement of the meatus but a reshaping of the glans which gives the illusion that the urethral meatus has been moved to the tip of the penis.

The incision line is drawn 5 mm behind the ectopic meatus and follows the cutaneomucosal junction of the prepuce. A deep vertical incision into the glanular groove for a distance of about one centimetre opens the dorsal meatus generously. Transverse closure of the diamond-shaped defect created flattens out the glanular groove and allows a straight stream to emerge.The ventral lip of the urethra is fixed with a holding stitch and brought forward. This tilts the glans to a more normal conical position and allows the lateral wings of the glans to rotate to the ventrum. A sleeve approximation of the penile skin is done, excising all redundant tissue and leaving a circumcised appearance. It seems that the MAGPI is particularly well indicated when the glans is broad and flat.

ii- Similar techniques: Other authors such as Arap [1] have slightly modified the MAGPI procedure to improve the cosmetic appearance. The Arap repair advances two flaps of lateral coronal tissue distally, approximating them in the midline, effectively lengthening the urethra. The glans is then closed over this tissue, normalizing its ventral appearance.

iii- The idea of using the mucosa of the distal groove (Fig. 9) to reconstruct minor hypospadias has been described by several authors: The Glans Approximation Procedure (GAP) [28] described by Zaontz is possible when there is a wide glanular groove. Righini and Gilpin (Glanular Reconstruction and Preputioplasty=GRAP) [15] resumed the same principle. Barcat [3] and Duffy reconstruct the distal urethra with one cutaneous flap and one glanular flap.

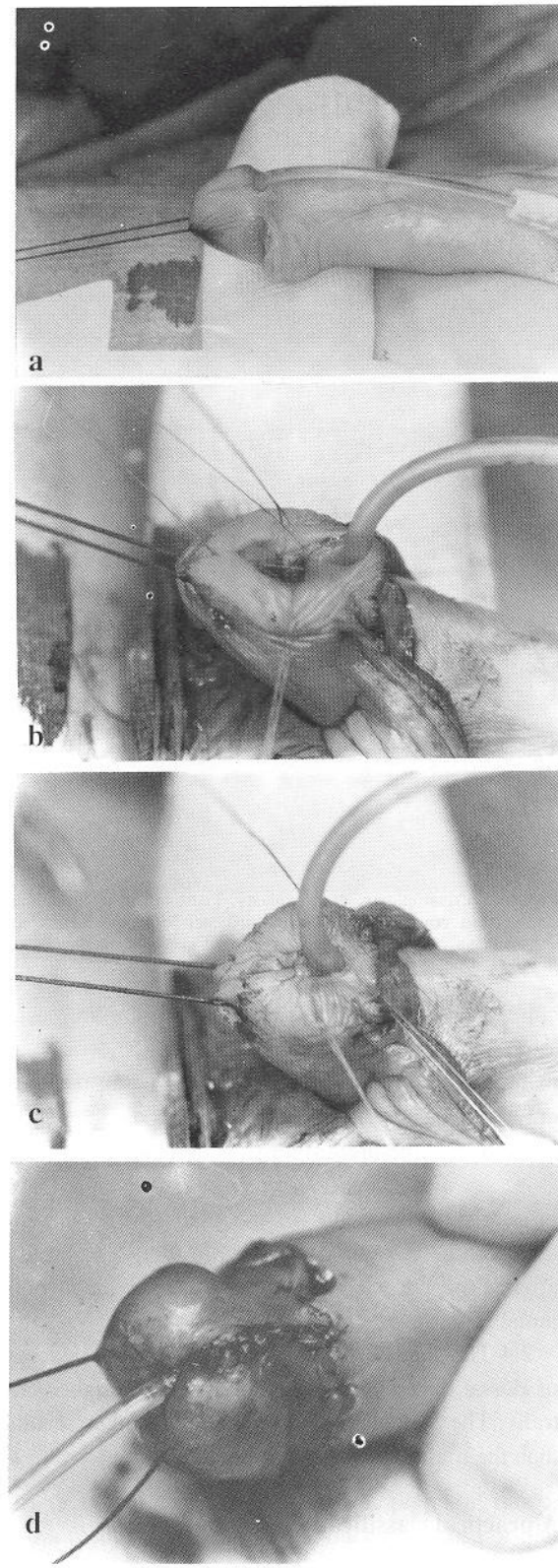


Figure 8. The MAGPI procedure described by Duckett in 1981. **a)** Glanular hypospadias, **b)** The deep vertical incision of the glans allows the relocation of the meatus, **c)** The transverse suture of the glans allows the reshaping (flattening) of the glans, **d)** Reconstruction of the ventral aspect of the glans.

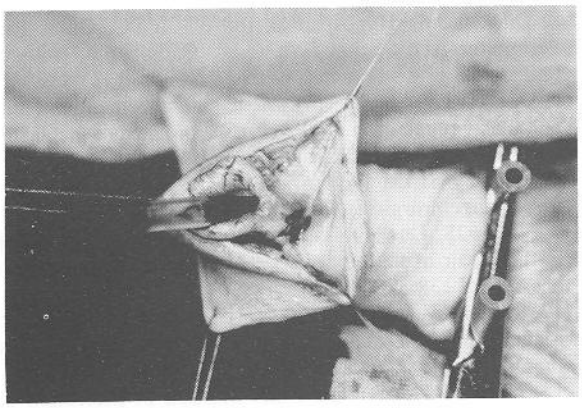


Figure 9. Dissection of the urethral plate in a glanular hypospadias.

Actually, in many cases of glanular or coronal hypospadias, the technique of Mathieu (described in 1932) can be used safely [18].

4.2 Anterior Hypospadias without chordee: Mathieu procedure (Fig. 10) [18]

Two parallel incisions are made on either side of the urethral plate up to the tip of the glans and deep down to the corpora cavernosum. The incision line delimits a perimeatal-based skin flap which is folded over and sutured to the edges of the urethral plate. The lateral wings of the glans are generously dissected from the corpora cavernosum. The rest of the procedure follows the recommendations given above.

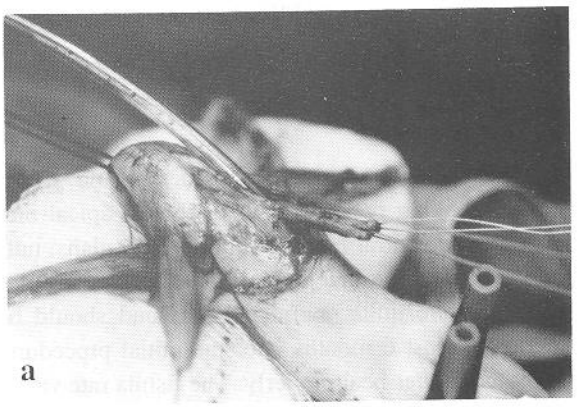
4.3 Any hypospadias with chordee (even posterior ones): YELSNAR** procedure v. supra (Fig. 3) [24].

Onlay procedures:

In these cases the urethral plate is lifted off the corpora cavernosum as described in **2.1** above. An onlay urethroplasty [11] is done using pediculized foreskin or buccal mucosa.

The Asopa-Duckett transverse preputial island flap technique [2,6] can also be used for this type of hypospadias. This technique ignores the urethral plate which is excised and uses a tubularized pedicle flap of foreskin which is interposed between the ectopic meatus and the glans. Because there is a circular anastomosis, the risk of stricture is higher here than in the Onlay procedures.

** The name YELSNAR has been chosen because this technique resumes the principles of RANSLEY's operation for epispadias (YELSNAR is RANSLEY read in reverse).



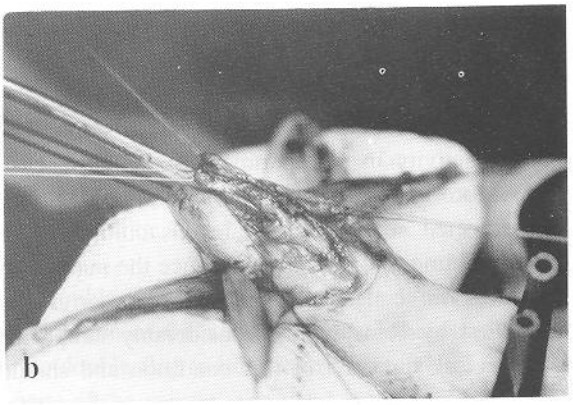


Figure 10 a) Mathieu procedure: The dissection of the skin flap is completed. **b)** The skin flap is folded over and urethroplasty can start.

Results

5.1 MAGPI. Duckett [9] reported in 1992 1,111 MAGPIs with 1.2% cases requiring secondary procedures. Partial ventral regression of the meatus is a possible complication of this procedure which remains the most popular one for glanular hypospadias [13].

5.2 Mathieu. Distal strictures are rare (1%) and fistulae are met in 4% of the cases [20]. The half-moon shaped meatus is sometimes disappointing but an extensive dissection of the 2 wings of the glans allows a nice glanuloplasty. The overall results remain excellent.

5.3 Onlay urethroplasty. It is a relatively new procedure, so the long-term outcome is unknown. In our series of 84 patients, 15% of the cases have fistulae among which 6% required a secondary procedure. No stricture has been recorded [24].

5.4 The transverse preputial island flap technique. The complication rate varies between 3.7% [12] and

69% [26]. Duckett reports a complication rate of 15% [8].

Conclusions

These modern surgical techniques should give a normal looking penis with a slit-shaped apical meatus, a nice ventral reconstruction of the glans, normal erections, normal micturitions. However complications are quite common [21,22] and should be treated at least 6 months after the initial procedure, to let the tissues heal properly. The fistula rate varies from 4% to 20% depending on the technique used and the experience of the surgeon. Urethral strictures are much rarer with the current urethroplasties which avoid circumferential anastomosis.

Hypospadias surgery represents the most important activity in a Department of Pediatric Urology. More improvements, i.e. more simplifications are expected such as urethral cells culture [4] or Laser welding [19] which may reduce the number of fistulae. The concept of urethral plate originally identified by Ransley has considerably simplified the surgical approach of this condition and should help young pediatric urologists to master these procedures.

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