

Reconstruction of Bladder Exstrophy in a Single-Stage

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Repair of exstrophy has an old tradition at the University of Erlangen. There was Karl Thiersch⁽¹⁾, Professor of Surgery from 1854 until 67 and he published about repair of epispadias and exstrophy. Since 1976 we perform complete reconstruction in a single-stage⁽²⁾. In 1983 we introduced our special bladder neck-plasty⁽³⁾ with improvement of continence to over 80% in our new series (1983 to 1993). This experience is based on 107 cases.

Early and complete functional closure offers many advantages:

It is much easier to create a continent bladder neck in a virginal exstrophied situs than after provisional closure behind pelvic ring adaptation with scarring or damage to the trigone.

Bladders with good outlet resistance develop their capacity faster.

Children are less stressed psychologically as further operations are mostly unnecessary.

We perform our single-stage reconstruction 6 weeks after birth or later (average age from 2 to 4 months). By then the necrotic umbilical cord has fallen off and the baby is better adapted for a long anesthesia of 5 to 7 hours. It is early enough to prevent polypoid mucosal hyperplasia and chronic inflammatory changes. No cases of dehiscence, bladder prolapse or wound infections were observed.

The essential steps of our reconstruction in a single-stage are as follows:

- (i) a special bladder neck-plasty for continence;
- (ii) preventive antireflux procedure (Cohen⁽⁴⁾ or modifications);
- (iii) penile lengthening with Johnston⁽⁵⁾ maneuver; complete urethral- and glanuloplasty;
- (iv) pelvic ring adaptation with our simple 3-cord-pull technique without iliac osteotomy, developed in 1977.

Bladder neck-plasty is the essential point for functional closure. Capacity and continence depend on two factors: outlet resistance and undamaged trigone for further bladder growth.

The most common bladder neck-plasty method is the Young-Dees-Leadbetter procedure^(6,7,8) with tubularisation of the trigone. In my opinion it has the following disadvantages:

1. Most of the trigone and the deep lateral wall (recessus) are wasted, that means one third or half of the bladder, as the exstrophied vesica is developed more across rather than upwards.
2. Vertical incisions in the trigone damage vascular and nervous supply with risk to further bladder growing. Instability and low compliance is reported in a high percentage. There are remarkable data from J.G. Hollowell⁽⁹⁾.
3. Suture lines of bladder neck are under transverse tension with imminent risk of rupture.

Therefore we returned to the former Young-Dees procedure with some vital modifications. We preserve most of the trigonal musculature and build an intubated natural trigonal loop reinforced by a detrusor loop and add the ring adaptation of the external sphincter region.

Details of our special bladder neck-plasty⁽³⁾

Fig. 1) First completely separate pubovesical and prostatic ligaments from the pubic rami down to the levator plane.

Fig. 2) Then an oblique incision is performed on each side up to the lateral margin between the upper and lower parts of undamaged trigone. The chosen cross distance in millimeters corresponds to the diameter of the intended bladder neck. The elastic trigonal muscle ring is closed with 3/0 PDS. The residual lumen is packed with mucosa. The incision of the vesical wall and pillars on both sides splits the

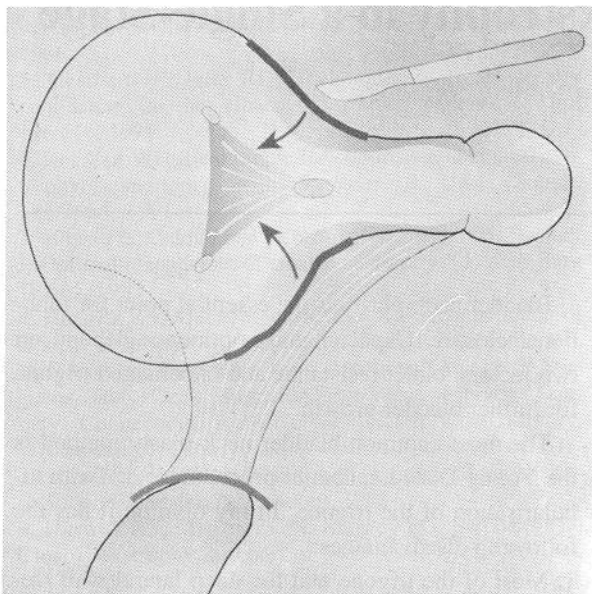


Figure 1.

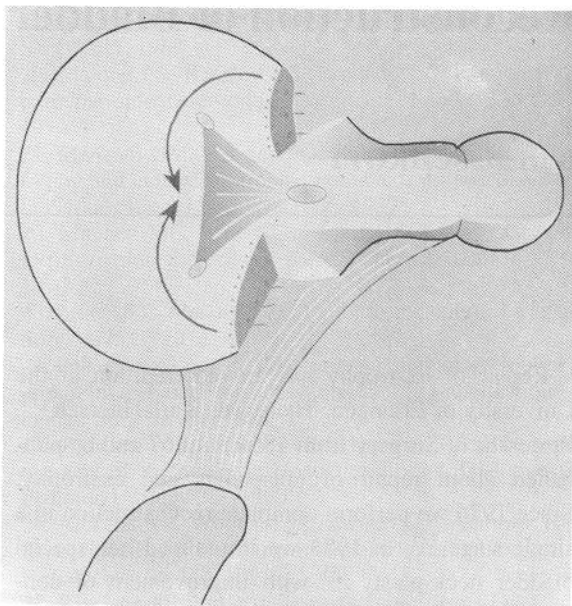


Figure 2.

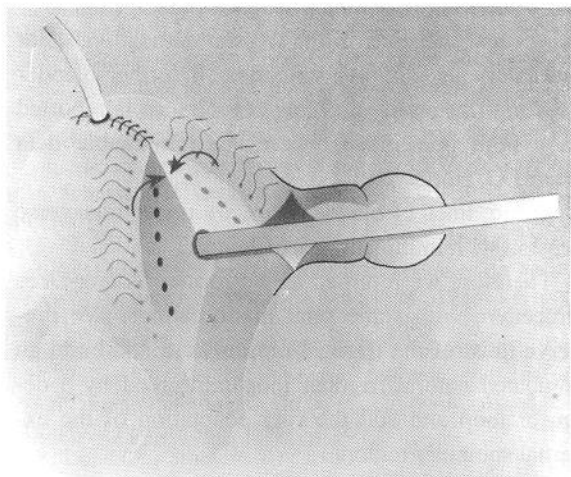


Figure 3.

area between bladder and posterior urethra together with its neurovascular bundle like between fingers. The penis is pushed outwards supporting the Johnston maneuver.

Fig. 3) It is easy to turn in the exstrophied bladder and to adapt the bilateral wings of the detrusor in a continuous layer to act as an anterior bladder wall. These detrusor wings need reinforcement by single sutures in front of the intubated trigonal muscle ring in the form of a so called detrusor loop. The closed bladder is then filled through a thin suprapubic catheter under pressure of 1 to 1.5 meters of water. No

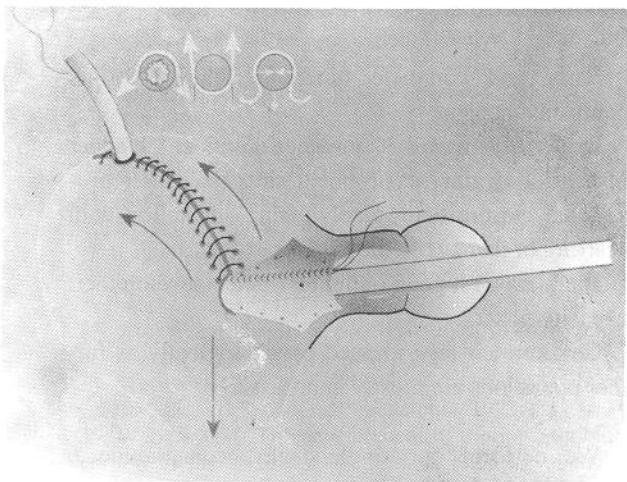


Figure 4. (Details in text).

dribbling should occur and you get a stream after active compression of the bladder.

Fig. 4) Next to the posterior epispadic urethral groove the paraextrophic tissues are denuded. The urethra is closed over a French 10 silicon catheter in a continuous layer. The strong puboprostatic mass with remains of the external sphincter is closed in the form of a natural omega-ring, based on the centrum tendineum. Hints of its partial function can be measured by microtip sphincterometry.

For further illustration, I show two examples (Fig. 5 and 6), one of a boy aged 4 months and a girl aged 6 months both with small plates. Postoperatively the

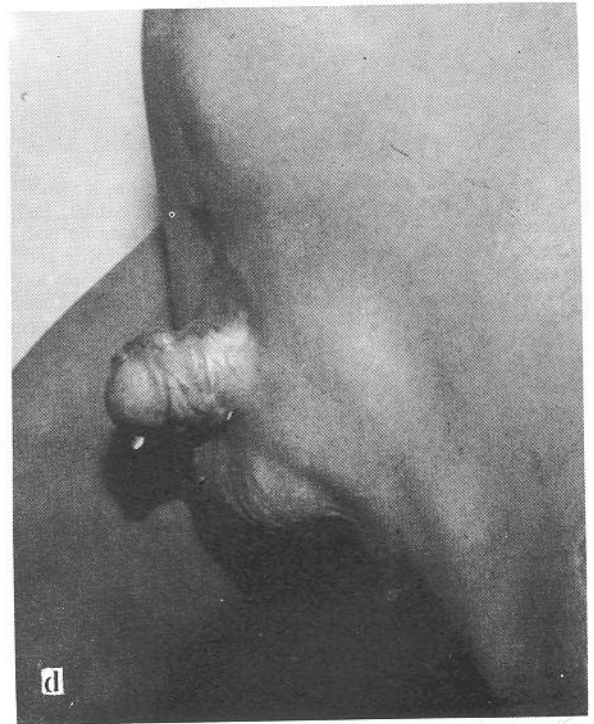
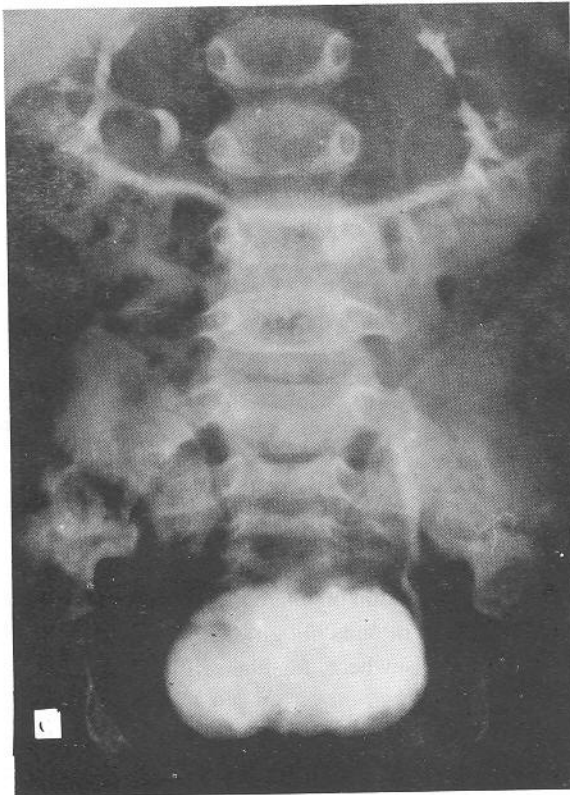
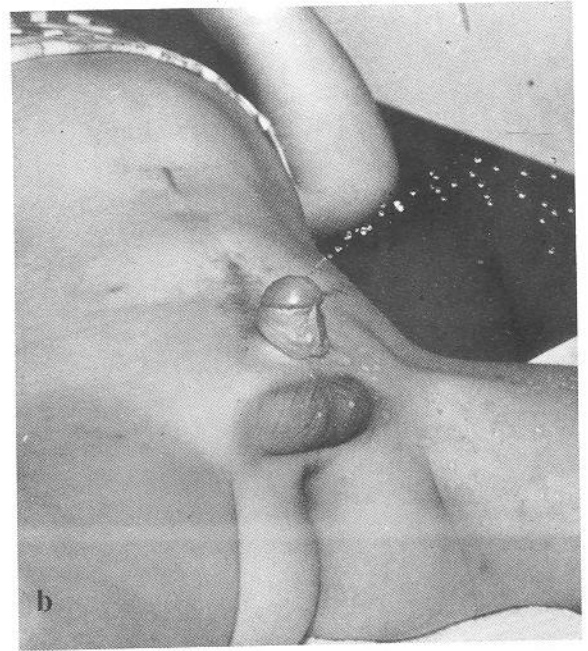


Figure 5 a). Small exstrophied bladder of a boy, 2 years and 4 months old, with polypoid hyperplasia. b) Spontaneous voiding without dribbling 2 months after total reconstruction together with urethroplasty and penile lengthening in a single stage, c) IVP (15 min) shows normal upper urinary tract and fair sized bladder growing 6 months postoperatively, d) After 12 months he has a bladder capacity of 80 ml. Cosmetic result is pretty good (with continence in long term result).

boy has well developed genitalia and bladder and is able to micturate with a full stream. IVP shows no obstruction. The voiding cystogram of the young girl shows a natural opening of the bladder neck.

After completing the urethral and glanuloplasty (modifications of Young-Cantwell^(6,10)) pelvic ring adaptation by our 3-cord-pull technique^(2,11) is per-

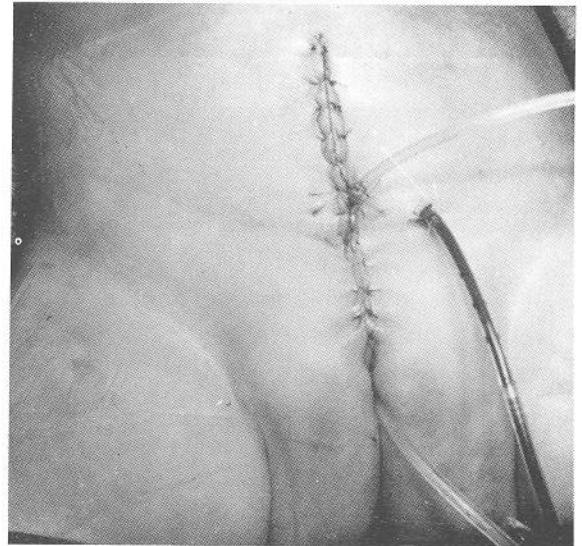
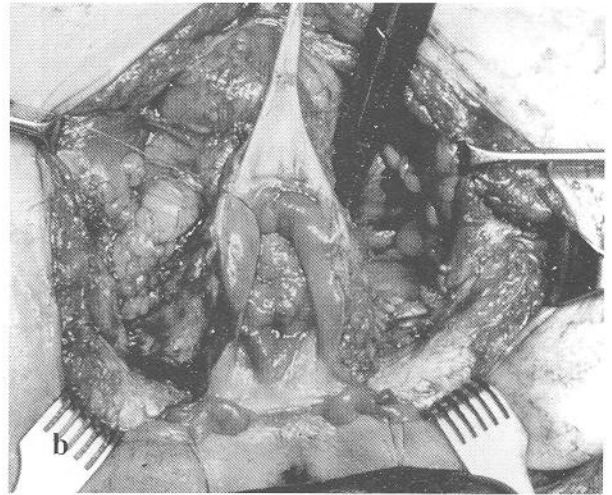


Figure 6 a). Bladder exstrophy of a 6 month-old girl with a small vesical plate, **b)** Total reconstruction in a single-stage. Pubovesical ligaments are dissected from the pubic rami on both sides downwards to the levator plane. Turning in is easily performed without tension or bursts later on. Bladder neck-plasty together with urethral prolongation and antireflux procedure is done before closure and approximation of the pelvic ring, **c)** Post-operative status with transurethral tube for 2 weeks and suprapubic catheter for 2 or 3 months (intermittently blocked for bladder training), **d)** Voiding cystogram 6 weeks after operation shows the initial opening phase of the dorsally intubated bladder neck. The anterior bladder wall stems against symphysis, **e)** After shortening and widening there is full micturition (after 12 months bladder capacity 60 ml, no urinary dribbling; 5 years later complete).

formed (Fig. 7). The pubic rami are approximated mostly to a distance of 1 to 2 cm without iliac osteotomy. The pubic rami are approximated using 3 strong twisted PDS-cords of 1 to 1.5 mm thickness. Each cord is tied over a single knot and clamped with a wide gripping needleholder. This maneuver is repeated for each cord in turn. On tightening of one the other two maintain countertraction. Contrary to this method a single monofile suture method tends to cut through the bone. The above technique was employed successfully in all 107 cases without rupture of the symphysis. (Notice the sutures of diaphragm are tied after pelvic ring adaption.)

I would like to demonstrate this simple method of pelvic ring adaptation on examples:

Fig. 8 a) This 4 months old girl had a burst after primary closure elsewhere, together with a rectal prolapse.

Fig. 8 b) Neck and antireflux plasty is performed before turning in. The rectum is fixed presacally against prolapse.

Fig. 8 c+d) Approximation of the pubic rami were achieved from 4 to less than 1 cm without iliac osteotomy. Pelvic tension is released for one week by means of a mummy bandage with legs held in adduction.

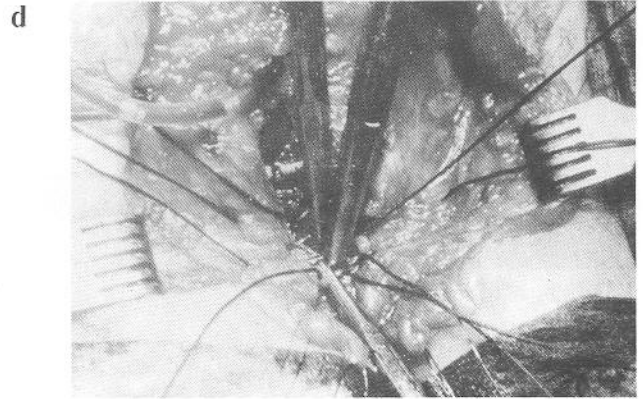
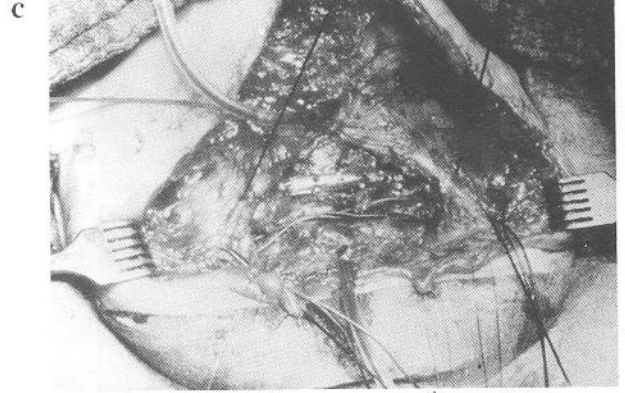
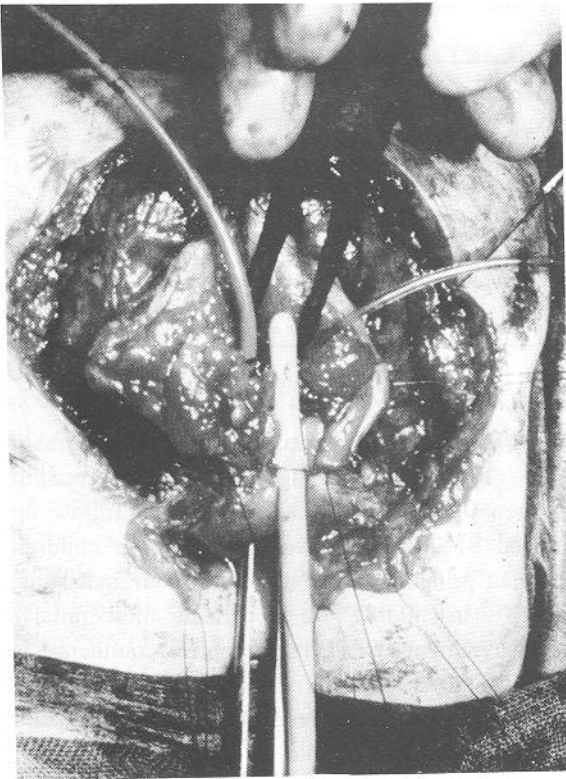
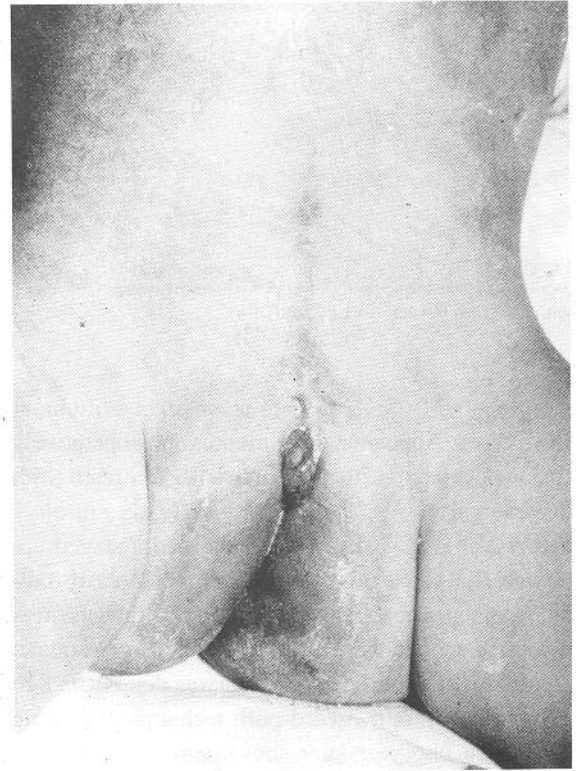


Figure 8 (a-e) See text.

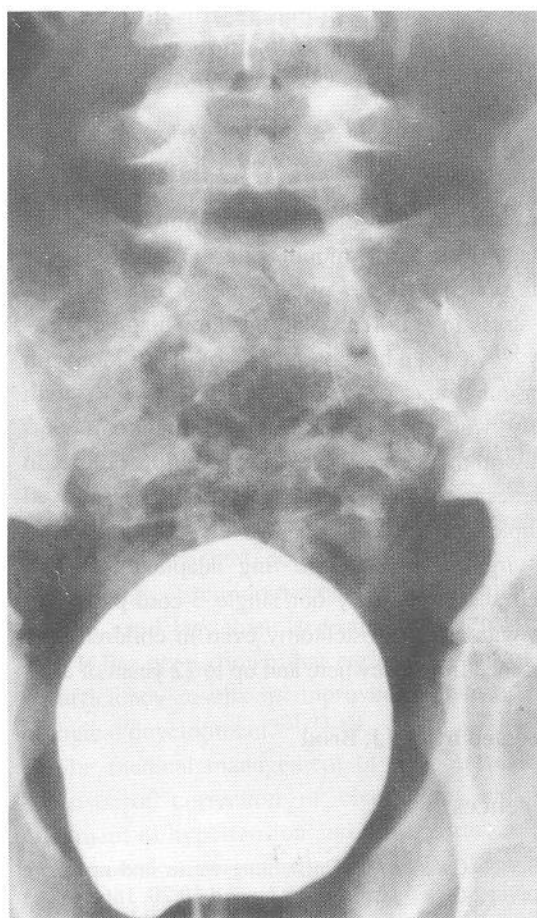
a



b

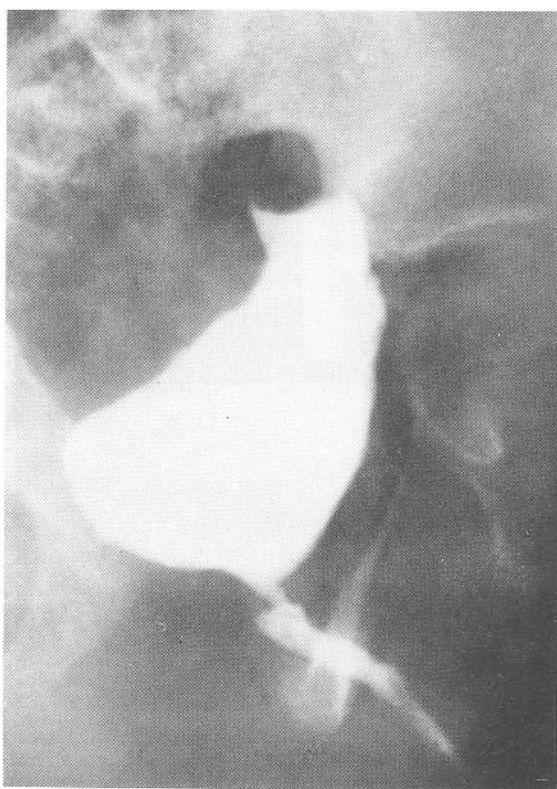


e



a

There was no case selection. All bladder exstrophies with a virginal situs and all failures from elsewhere with residual bladders or plates were reconstructed. We had zero mortality and no case of



b

Figure 9 a, b. (Details in text).

bladder prolapse. We have transient slight or minor obstruction of the upper urinary tract (or reflux) during the so called training phase of the bladder in the 2nd to the 3rd month (after stent removal) under protection of an intermittently blocked suprapubic catheter. But only 2 patients showed significant upper urinary tract deterioration later on.

Table 2. Continence and urodynamics, New series Erlangen 1983-93

		involuntary detrusor contractions	low compliance bladder	elevated voiding pressure	urethral pressure profile [cmH ₂ O]
I. Prim. reconstruction in infancy (n=12)					
day and night compl. dry	10 (83 %)	0	1	3	30-105
partial continent					
- bladder cap. < 80 ml	1	0	0	1	60
- bladder cap. > 100 ml	1	0	0	0	30
II. Sec. reconstruction after treatment outdoors (n=20)					
day and night complete dry after bladder augmentation	9 3 (60%)	0 0 (3)	1 0 (3)	6 0	20-89 20/30/67
partial continent					
- bladder cap. < 80 ml	6 (40%)	4	4	0	45-75
- bladder cap. > 100 ml	2	1	1	0	17-20

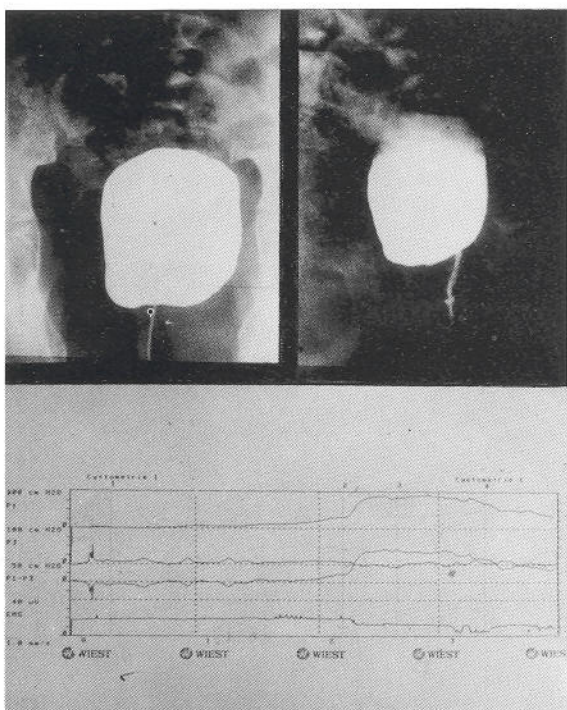


Figure 10. Voiding cystogram of an 11 year-old girl with bladder capacity from 160 to 200 ml and no residual urine (upper urinary tract is normal). She has powerful detrusor contractions with a maximum of 90 cm of water (P1-P3=bladder pressure-rectal/intraabdominal pressure). She is completely dry by day and by night (only nicturia once).

From this group of 49 children in long-term follow up 32 were investigated by urodynamic studies (Table 2). In the 12 children who underwent primary single-stage reconstruction in infancy there was only one case with a low compliance bladder and none had involuntary detrusor contractions. On the other hand nearly half of the children after secondary reconstruction, following failed treatment elsewhere, had involuntary detrusor contractions and low compliance bladder. This is a sign of partial denervation and devascularization after Young-Dees-Leadbetter procedures. J.G. Hollowell et al. had already demonstrated this in cases with epispadias repair (9). Three of the latter children only achieved complete dryness by bladder augmentations using sigma pouches with the need for transient intermittent self catheterization.

For final demonstration (Fig. 10) in most of our primary reconstructions we have good detrusor contractions with a maximum of 70 to 90 cm of water below a dangerous high pressure situation. Our preliminary cholinergic and adrenergic receptor analy-

sis or specific staining of muscle strips from trigone and posterior detrusor is normal in virginal bladder exstrophy.

Conclusions

Early reconstruction of bladder exstrophy in a single-stage (from 2 to 4 months after birth on average) avoids scarring of the situs and a lot of psychological stress in children. With our new bladder neck-plasty (3) we get a high protection of the trigone with its vascular and nerve supply for further growth (mostly with normal detrusor contractions) compared with the Young-Dees-Leadbetter procedure. In our series from 1983 to 1993 (107 cases) we achieved a complete continence rate of over 80% in children with virginal situs. Pelvic ring adaptation is performed successfully by our single 3-cord-pull technique without iliac osteotomy even in children with dehiscence from elsewhere and up to 12 years of age.

Translated by Dr. J. Brod

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