

From the Department of Orthopaedic Surgery (Head: Professor T. H. Hiertonn, M.D.)  
and The Department of Pediatric Surgery (Head: Assoc. Prof. G. Grotte, M.D.),  
University of Uppsala, Sweden.

## A MODIFIED TECHNIQUE FOR PELVIC RECONSTRUCTION IN THE TREATMENT OF EXSTROPHY OF THE BLADDER

By

G. GROTTÉ and J. A. SEVASTIKOGLÓU

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Exstrophy of the bladder is a relatively rare congenital malformation occurring once in every 30,000 to 50,000 births (*Higgins 1959, Campbell 1961, Sorrentino & Leonetti 1958, Swenson et al. 1963*). Apart from the pure urogenital malformation this condition is also combined with a severe derangement of the pelvic ring. Diastasis of the symphysis pubis, often surpassing 10 cm, posterolateral displacement of the acetabula with a pronounced external rotation and restricted internal rotation of the legs, result often in instability of the gait in the growing child (*O'Phelan 1963*).

Until recently the treatment of this condition was directed towards the surgical reconstruction of the urogenital deformity, with, as a rule, very poor results. As early as 1906 Trendelenburg performed a combined reconstruction of the pelvic and the urogenital deformity by separation of the sacroiliac synchondrosis in order to obtain approximation of the pubic bones before the reconstruction of the bladder. The method was, however, abandoned because of technical difficulties and the poor results obtained. *Nixon 1957* by manual osteoclasis of the pelvis obtained successful closure of the bladder in two newborn babies. *Schultz (1958)* and *Swartzman* were the first to use a bilateral parasacral osteotomy of ilium to secure better possibilities for the approximation of the pelvic bones and hence improvement of the urogenital reconstruction. Since then the combined reconstructive procedure has been used by several authors and very enthusiastic results have been reported during recent years (*Schultz 1958, Lloyd-Roberts et al. 1959, Johansson 1963, O'Phelan 1964*). The operative

technique used by these authors consists of bilateral osteotomy of the ilium during a first stage and the reconstruction of the urogenital and symphyseal deformity in a second stage, usually one to two weeks after the first. In the reported cases the approximation of the symphysis has been secured either by the ilium osteotomies alone and the subsequent compression of the pelvis by a spica plaster cast or splints, or by internal fixation of the pubic rami with a wire loop or a strip of fascia lata applied through the obturator foramina during the second stage of the reconstruction. Better results regarding the approximation of the symphysis are secured by this fixation. In several cases, however, failure to maintain a lasting approximation of the pelvis bones has been reported. Recurrence of the diastasis and erosion of the urethra have been reported in some of the cases.

In four cases of exstrophy of the bladder operated upon by us a somewhat modified technique has been used for the maintenance of the approximation of the symphysis. The reconstructive procedure used in these cases and the results obtained in two of them are reported herewith.

#### THE RECONSTRUCTIVE PROCEDURE

The reconstructive procedure comprises 3 separate operations, performed in two stages. At the first stage a bilateral parasacral osteotomy is made. One to two weeks later the urogenital reconstruction and the fixation of the symphysis pubis are performed during the second stage.

##### *First Stage*

##### *Bilateral Parasacral Osteotomy of the Ilium*

Under general anaesthesia and intubation the child is placed prone on the frame for the lumbar spine surgery. In this position the posterior limits of the pelvis are prominent and easily recognised. The skin incision starts parallel to the posterior iliac crest and is directed to the superior limit of the sacroiliac joint, where it swings caudally parallel to it. The attachment of the gluteus maximus muscle is mobilized and retracted laterally so that the parasacral portion of the ilium is freed from the crest down to the greater sciatic notch. Through an incision on the fascia lumboiliaca on the crest a finger is passed and the ventral surface of the ilium is freed bluntly near the sacroiliac joint in the caudal direction. In the same way dissection is performed

from the greater sciatic notch cranially. Two retractors are then pushed gently along the ventral surface of the ilium to meet each other and to protect the underlying tissues during the osteotomy. Division of the ilium is performed by a Stryker's saw, 1 to 2 cm lateral to the sacroiliac joint and parallel to it. When the osteotomy has been accomplished the ilium is mobilized and moved laterally. The sacrotuberous ligament is then stretched preventing complete diastasis within the caudal part of the osteotomy. When stretched the ligament is easily recognized and divided as advocated by Lloyd-Roberts et al. Satisfactory diastasis within the osteotomy of 1-1½ cm is then easily obtained. Before closing the wound a bone strip, 0.5 cm broad, is removed from the iliac bone at the site of the osteotomy on each side with the electric saw. Under sterile conditions it is preserved in a jar and deep frozen to be used as transplantation material for the reconstruction of the symphysis pubis. When the procedure has been accomplished on both sides and the wounds are closed, the iliac bones are compressed gently to each other and then immobilized under slight pressure with broad strips of elastoplast dressing.

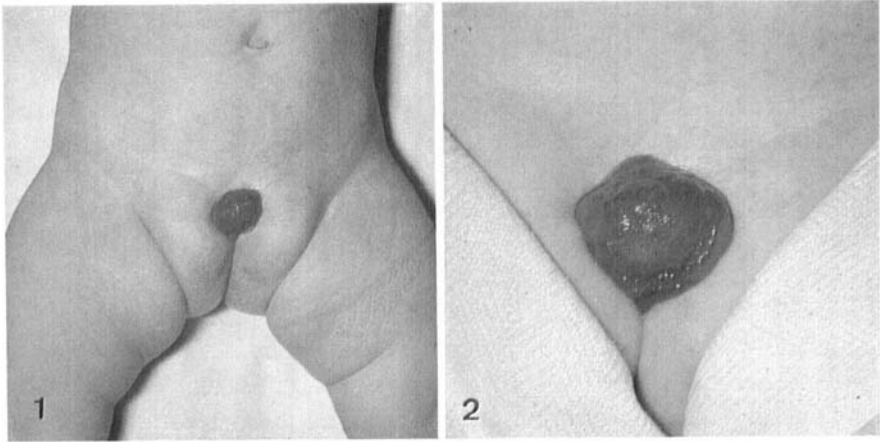
### *Second Stage*

#### *1. The Urogenital Reconstruction*

A horseshoe-shaped incision is made around the bladder except along the urethra. The bladder is extensively mobilised posteriorly down to the trigonum. The intersymphyseal band is detached from the pubic tubercles by subperiosteal dissection. After adequate mobilisation the bladder and urethra are carefully reconstructed over a no. 12 Malecot-catheter. The reconstruction is made in two layers using 3-0 chromic catgut sutures. The intersymphyseal band is coapted like a collar around the bladder neck. Improvements of this technique using suprapubic sump drainage and pressure studies during the reconstruction of the bladder neck have been suggested by Swenson et al. (1963), but were not used in the present cases. The incisions mobilizing the bladder and the bladder neck and especially reconstruction of the bladder under dissection microscopy (Leitz operation microscope) greatly facilitate the procedure.

#### *2. The Fixation of the Symphysis*

When the reconstruction of the urogenital deformity has been accomplished the medial aspects of the pubic bones are freed by blunt

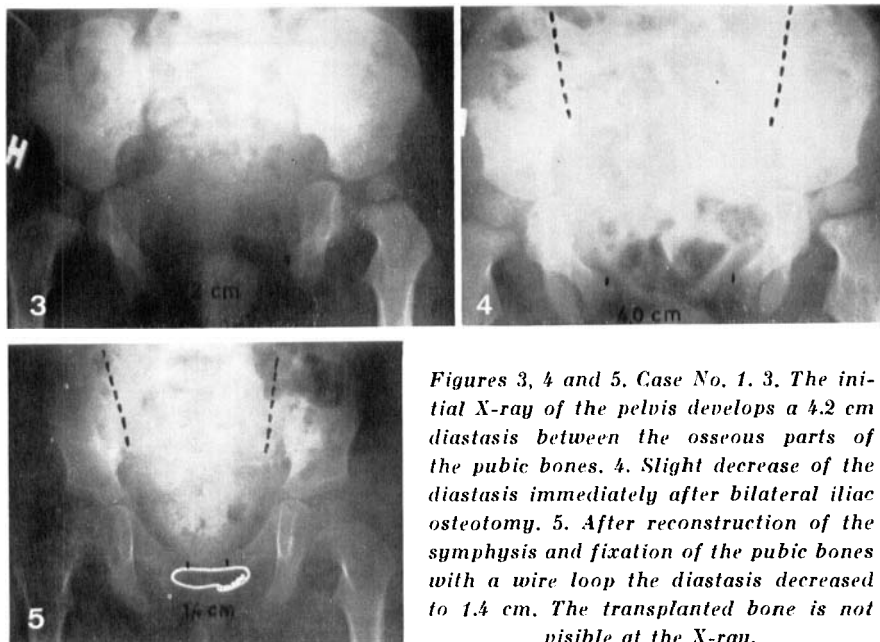


Figures 1 and 2. Case No. 1. The bladder exstrophy at birth.

dissection down to the obturator foramina through the same skin incision. A stainless steel wire is passed around the rami of pars pubica of the sciatic bones which are pushed together to complete approximation, before the wire loop is tightened. An incision is then made on the upper surface of the cartilaginous pubic parts until the ossified central region of the bones is revealed. The bone fragments removed during the first stage from the site of the iliac osteotomy and kept in the deep freezer are thawed and inserted within the prepared cartilaginous cleft to reach contact with the ossification centre of the bone. An amount of bone chips is packed around the bone graft. After closure of the wound a spica plaster cast is applied with the iliac bones under slight pressure to each other and the legs kept in a neutral position and in slight abduction. After 4–6 weeks the plaster cast is removed and immobilization continues for another 2–4 weeks by means of a splint as advocated by *Sweetser* (1960). At this time the iliac osteotomies are usually healed and the child is allowed out of bed.

#### CASE REPORTS AND RESULTS

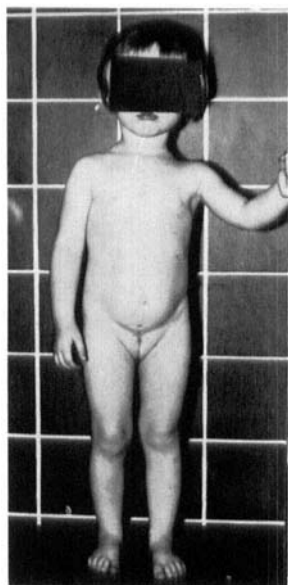
*Case 1.* The first case concerns a female baby, the only child in the family, born after a full term pregnancy with an urogenital deformity. No other congenital malformations. No heredity of congenital abnormalities. She was admitted to the department of pediatric surgery from another hospital 3 weeks after partus. At the time of admission the urogenital deformity consisted of a complete epispadias and exstrophy of the bladder (Figures 1 and 2). I. v. pyelography showed no anomalies of the kidneys and the upper urinary tract. No pathologic urine flora. The ortho-



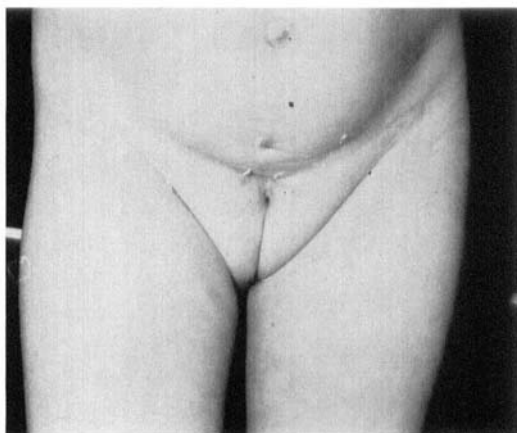
Figures 3, 4 and 5. Case No. 1. 3. The initial X-ray of the pelvis develops a 4.2 cm diastasis between the osseous parts of the pubic bones. 4. Slight decrease of the diastasis immediately after bilateral iliac osteotomy. 5. After reconstruction of the symphysis and fixation of the pubic bones with a wire loop the diastasis decreased to 1.4 cm. The transplanted bone is not visible at the X-ray.

paedie examination revealed a distasis of the symphysis of at least 4 cms, confirmed also by X-rays (Figure 3). In a lying position the patient keeps her legs slightly abducted. There is, however, a normal stability and range of motion within both hip joints. The Ortolani test is bilaterally negative. The girl started to walk at the age of 13 months, with apparently normal gait for this age. When standing up the legs are kept slightly abducted, but there is still normal range of motion and normal stability within both hips. There was a slight bow leg deformity at the time of surgery. The girl was operated upon at the age of 1 year, 4 months. Bilateral iliac osteotomy was performed first (Figure 4) and 12 days later surgery for reconstruction of the urogenital deformity and the symphysis followed (Figure 5), according to the described technique. The pelvis and the legs were immobilised with a plaster cast for 6 weeks and later with a special splint for another 4 weeks. She started to walk again as soon as the splint was removed. She now keeps her legs in midposition when standing up. The Trendelenburg sign is negative bilaterally.

Because of erosion of the wire loop through the pubic bones and through the anterior wall of the urethra the wire was removed 9½ months after the reconstruction of the symphysis. At the latest follow-up examination, 16 months after surgery, the girl is 2 years 8 months old. She grows normally. She walks and runs uninhibitedly. The gait is normal. The operation scars are well healed (Figures 6 and 7) with no tenderness at palpation. The pubic bones are well approximated and a bony continuity is felt overlapping the symphysis. There is no leg length discrepancy. The pelvis is horizontal with no deviation of the spine. She keeps her legs in normal midposition when standing up. There is normal range of motion within both hips. The bow-leg deformity has disappeared. There is only a moderate flat foot deformity



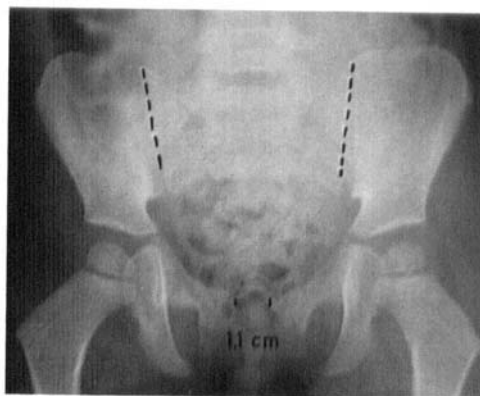
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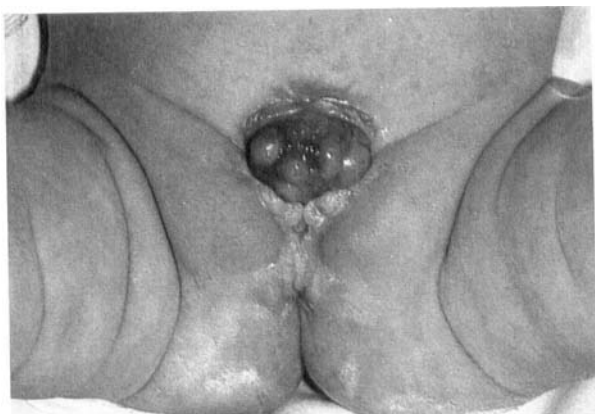
*Figures 6 and 7. Case No. 1. Sixteen months after the operation. 6. The position of the legs is normal. 7 The scar after the abdominal surgery is well healed.*

*Figure 8. Case No. 1. X-ray of the pelvis 16 months after the operation. The diastasis between the osseous parts of the pubic bones has decreased to 1.1 mm. The bone transplant is not visible but there is a slight osteogenetic reaction from each of the pubic bones.*

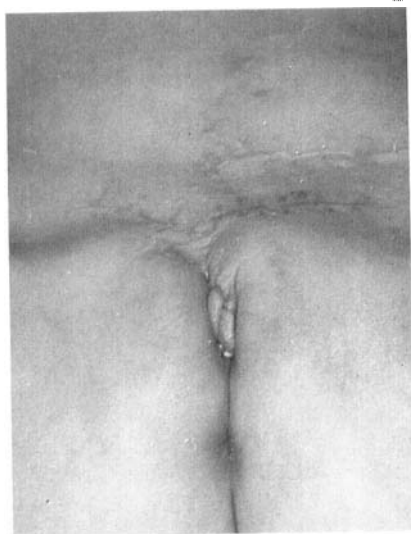


necessitating no treatment. The X-rays show complete healing of the iliac osteotomies. There is only an 11 mm diastasis between the bony parts of the pubic bones (Figure 8). The transplanted bone in the symphysis is not visible but there are some visible signs of osteogenesis from both pubic bones at this place. The urogenital condition is very satisfactory. The girl is fairly continent. She often says when she needs to urinate but is seldom dry for longer than  $\frac{1}{2}$  hour. There is no continuous leakage of urine as before the operation. The voiding cytogram shows a somewhat widened bladder neck which, however, tightens towards the urethra. At urography the bladder is filled up with contrast in a normal way and is emptied completely during micturition. The i. v. pyelography is normal.

*Case 2.* This case concerns also a female infant, the second child in a family with 2 children. No heredity of congenital abnormalities. She was born after a full term pregnancy, with a severe exstrophy of the bladder (Figure 9). No other congenital malformations are present. No orthopaedic examination was performed immediately after birth. At the age of 2 months the girl was admitted to the Department of Plastic Surgery where reconstruction of the bladder, the bladder neck and the urethra was performed. The procedure resulted in a successful closure (Figure 10). The urinary incontinence was, however, unaffected. Except for several attacks of pyelonephritis the girl developed severe difficulties with micturition *i.e.* pain and retention for which catheterization of the bladder was necessary on several occasions. The patient was admitted to the Department of Pediatric Surgery at the age of 3 years 4 months. A bladder stone was diagnosed and removed. Stricture of the bladder neck was assumed to be the reason of her retentions and since catheterization

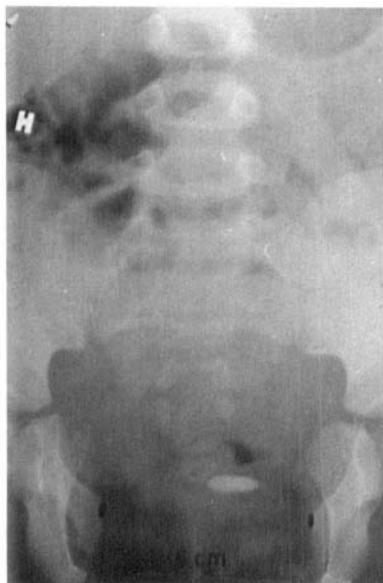


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*Figures 9 and 10, Case No. 2. 9, The bladder exstrophy at birth. 10, A successful closure of the abdominal wall has been obtained after the first reconstruction operation.*



*Figures 11. Case No. 2. The initial X-ray of the pelvis shows a 6 cm diastasis between the osseous parts of the pubic bones.*

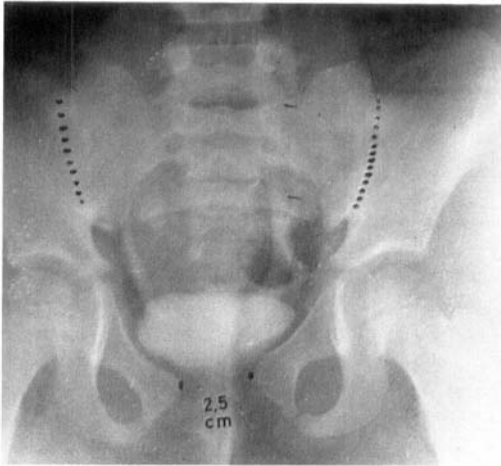
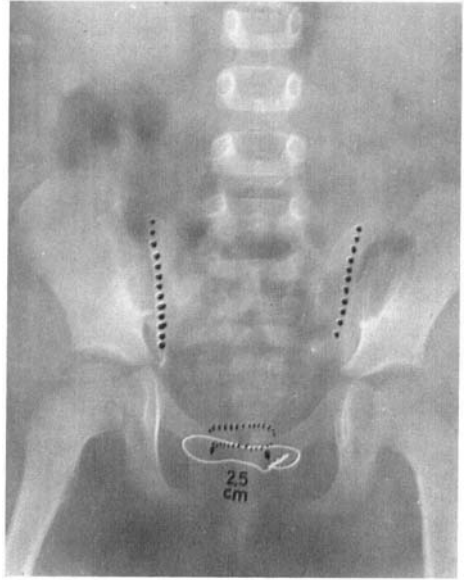


*Figures 12. Case No. 2. Immediately after iliac osteotomies the diastasis decreased to 4 cms.*

and dilatation failed to give any result it was therefore decided to operate on her again. The first orthopaedic examination revealed a well developed 4 year old girl. She started to walk at the age of 1 year 4 months. No remark was found on the records of any early statical or walking disorder. The gait is stable and normal. There is no pathologic finding from the hips. No abnormal posture of the legs exists when standing. There is a diastasis of the pubic bones of almost 7 cm. The pelvis and the spine look normal. X-ray examination of the pelvic girdle shows a diastasis of the pubic bones of 6 cm (Figure 11). Bilateral iliac osteotomy was performed at



*Figure 13. Case No. 2. Reconstruction of the symphysis and fixation of the pubic bones by a wire loop decreased the diastasis to 2.5 cms. Note the bone transplant over the symphysis.*



*Figure 14. Case No. 2. Two months after the removal of the wire loop the distance between the osseous parts of the pubic bones is still unchanged. The transplant is not visible longer. No signs of osteogenesis at the site of transplantation.*

the age of 4 years 2 months (Figure 12). Eight days later a reconstruction of the symphysis was performed (Figure 13) and at the same time resection of scar tissue around the bladder and the bladder neck was performed. A good mobilization of the bladder was then obtained, and its reposition in the pelvis became possible. The abdominal wall was easily reconstructed. The pelvis and the legs were immobilized by a plaster cast for 10 weeks and by a splint for another 4 weeks. Thereafter the girl was up and moved freely within a few days. The wire loop was removed 5½ months later (Figure 14) since it had eroded through the pubic bones and the anterior wall of the urethra.

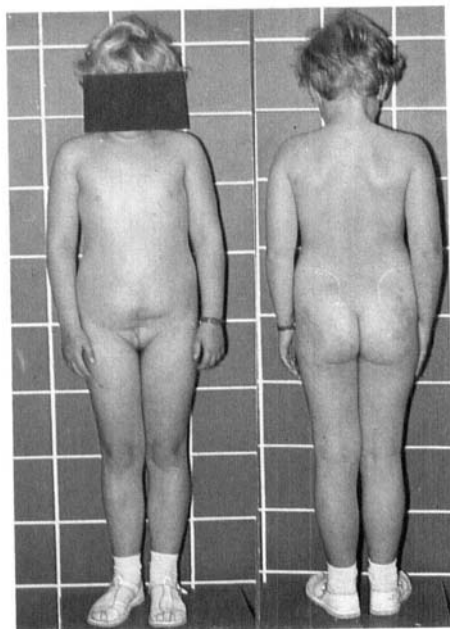


Figure 15

Figure 16

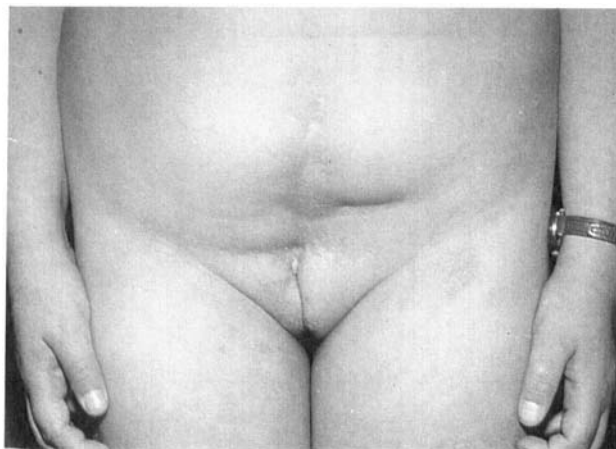
*Figures 15 and 16, Case No. 2 at followup examination 3 years 6 months after the operation. 15 the scars after the iliac osteotomies are visible. 16. The slight outward rotation of the right leg is occasional.*

At the last follow up examination 3 years 6 months after surgery the girl is 7 years 8 months old and she has developed in a normal way. She walks and runs freely. The gait is normal. The operation scars are well healed (Figures 15, 16 and 17) with no tenderness on palpation. The pubic bones are felt well approximated and there is a bony continuity overlapping the symphysis. Normal range of motion exists within both hips. There is no leg length discrepancy. The legs are in the midposition when standing up. Somewhat increased lumbar lordosis. The pelvis is horizontal. There are no pathologic deviations of the spine. On X-ray examination the iliac osteotomies were completely healed. The diastasis between the osseous parts of the pubic bones has remained unchanged since the operation (Figure 18). The transplanted bone in the symphysis is not visible on the X-ray and there are no signs of osteogenesis at this place either. The urogenital condition is more or less unchanged. There is still a complete incontinence of the bladder. The girl had had several attacks of pyelonephritis after the operation as well, but no pain at micturition and no residual urine. The i. v. pyelography reveals a slight dilatation of both kidney pelvis and ureters.

#### DISCUSSION

the major problems in surgery. Different methods of reconstructing the urogenital deformity gave but very poor results, primarily because of The treatment of the exstrophy of the bladder has always been one of

*Figure 17. Case No. 2 at followup examination 3 years 6 months after the operation.—The scars after the abdominal surgery are well healed.*



*Figure 18. Case No. 2. X-ray of the pelvis 3 6/12 years after the operation. The diastasis between the pubic bones is still unchanged. There is no bony union at the place of bone transplantation.*

the failure to close the symphyseal gap, which is the key to success in treating this condition (Matthews 1958). Iliac osteotomy and approximation of the symphysis increased considerably the possibilities of successful reconstruction of this extremely severe malformation. The chief virtue of the pelvic reconstruction is the fact that the soft tissues are brought more closely together and thus make it possible that urinary control may be better at a later date. There is no necessity for skeletal reconstruction since the posture and moving activities in older cases with no reconstruction of the pelvis have been reported to be fairly normal (Lattimer *et al.* 1960). Since the introduction of the

Table 1

| Author                          | No. of cases | Partial obstruction or erosion of the urethra by the wire |
|---------------------------------|--------------|-----------------------------------------------------------|
| Schultz (1958)                  | 1            | No complication reported.                                 |
| Lloyd-Roberts & Braddock (1959) | 7            | No wire fixation of the symphysis was used.               |
| Lattimer et al. (1960)          | 4            | In all the cases.                                         |
| Chisholm (1961)                 | 12           | In 10 cases.                                              |
| Johanson et al. (1962)          | 4            | No complications reported.                                |
| O'Phelan (1963)                 | 24           | In all the cases.                                         |

combined procedure by *Schultz* (1958), reports have been published by different authors, who obtained very encouraging results by using this method. However, because of the rarity of the condition the reported series comprise relatively small number of cases (Table 1) and the experience gained until now can by no means be considered as definite. A common complication in the reported cases treated by either iliac osteotomy alone or combined with approximation and fixation of the symphysis by wire or fascia lata, is an increasing diastasis of the symphysis after the removal of the plaster cast and the compression of the pelvis. Erosion of the wire loop through the pubic bones is very common, and it is followed by loosening of the primarily obtained approximation of the symphysis. Displacement of the wire includes the risk of a partial or complete obstruction of the urethra and the loop must therefore be removed as soon as signs of erosion of the pubic bones are present in the x-ray examination. Removal of the wire is also recommended as soon as the iliac osteotomy is healed and the child is allowed up (*O'Phelan* 1963). Erosion of the wire through the bones and its removal are always followed by a relapse of the diastasis of the pubic bones, resulting in tension on the bladder neck and the urethra which might influence bladder continence. This complication is usually the reason for the failure of the urogenital reconstruction (*Trendelenburg* 1906). To overcome this complication bone transplantation has been used by the authors, in addition to the wiring of the pubic bones. In the reported two cases no relapse of the diastasis occurred, although the wire had to be removed approximately 9½ months after the operation in the first case. In the second case the wire was removed 5½ months after the operation and there is no increase of the diastasis 3 years 6 months

after the operation either.<sup>1</sup> The maintenance of the approximation obtained primarily is apparently due to the bone transplantation. A bony bridge overlapping the symphysis was felt at the clinical examination of the patients and although not visible in the x-rays it keeps the pubic bones in close approximation.

It was suggested earlier that reconstructive surgery for exstrophy of the bladder must be undertaken preferably at the age of about one year. In the reported cases the best results were obtained when the patients were operated earlier and surgery immediately after birth gave in one case satisfactory primary results.

### SUMMARY

A modified technique for pelvic reconstruction in the treatment of exstrophy of the bladder has been used by the authors in 4 cases. The use of bone transplantation for the stabilisation of the approximated pubic bones during the reconstruction of the symphysis gave in every case good primary results with no relapse of the pubic diastasis, although the used wire loop was removed shortly after the operation. Two of the cases with a follow-up of 1 year 4 months and 3 years 6 months respectively are reported.

### RESUME

Une technique modifiée de reconstruction pelvienne dans le traitement d'une exstrophie de la vessie a été utilisée par les auteurs dans 4 cas. L'utilisation de transplantation osseuse pour la stabilisation des os pubis pendant la reconstruction de la symphyse a donné dans chaque cas de bons résultats primaires sans relâchement de la diastase pubienne, bien que la bride utilisée ait été retirée peu après l'opération. Deux cas suivis pendant un an un tiers et 3 ans et demi, respectivement, sont rapportés.

### ZUSAMMENFASSUNG

Eine abgeänderte Technik zur Beckenrekonstruktion bei der Behandlung der extrophischen Blase wurde von den Verfassern in 4 Fällen

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<sup>1</sup> Another two cases were recently operated on by the authors, one of which concerned a 3 days old female baby. In both cases a teflon arterial prosthesis 5 mm in diameter was used for the fixation of the reconstructed symphysis instead of a wire loop. In both cases because of an extensive local reaction and suppuration the fixation material was removed shortly after the operation. No loosening of the primarily obtained approximation has been observed 2-3 months later.

angewendet. Die Verwendung von Knochentransplantaten zur Stabilisierung der angenäherten ossa pubica während der Rekonstruktion der Symphyse gab in jedem Falle gute primäre Resultate ohne Rückfall der pubischen Diastase, obwohl die verwendete Drahtschlinge bald nach der Operation entfernt wurde. Über zwei Fälle mit einer Beobachtungszeit von 1 4/12, beziehungsweise 3 6/12 Jahren wird berichtet.

#### REFERENCES

- Campbell, M. (1961) Clinical Pediatric Urology. Saunders Co., London and Philadelphia.
- Chisholm, T. C. (1961) Exstrophy of the urinary bladder. *Amer. J. Surg.* **101**, 649.
- Higgins, C. C. (1959) Exstrophy of the bladder. Review of 156 cases. *J. amer. med. Ass.* **171**, 114/1922.
- Johanson, B., Joshi, M. & Kollberg, S. (1962) Exstrophy of the bladder. *Acta chir. scand.* **124**, 508.
- Lattimer, J. K., Dean, A. L., Jr., Dougherty, L. J., Jr., D., Ryder, C. & Uson, A. (1960) Functional closure of the bladder in children with exstrophy: A report of twenty-eight cases. *J. Urol.* **83**, 647.
- Lloyd-Roberts, C. C., Williams, D. I. & Braddock, G. T. F. (1959) Pelvic osteotomy in the treatment of ectopia vesicae. *J. Bone Jt Surg.* **41 B**, 754.
- Matthews, D. N. (1958/59) Ectopia Vesicae. *Brit. J. plast. Surg.* **11**, 188.
- Nixon, H. H. (1959) Cited by Lloyd-Roberts et al.
- O'Phelan, H. E. (1963) Iliac osteotomy in exstrophy of the bladder. *J. Bone Jt Surg.* **45 A**, 1409.
- Schultz, W. G. (1958) Plastic repair of exstrophy of bladder combined with bilateral osteotomy of ilia. *J. Urol.* **79**, 453.
- Sorrentino, F. & Leonetti, P. (1958) Terapia della estrofia vesicale. Napoli.
- Sweetser, T. H. (1960) Plastic reconstruction for exstrophy of the urinary bladder. *Sth. med. J.* **53**, 1519.
- Swenson, O., Nussatos, G. H. & Fischer, J. H. (1963) Results of Repair of Exstrophy of the Bladder. *The Surg. Clin. N. Amer.* **43**, 151.
- Schwartzmann, J. R. (1958) Cited by Schultz.