

CLINICAL RESULTS WITH ANTERIOR DIAGONAL ILIAC OSTEOTOMY IN BLADDER EXSTROPHY

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ABSTRACT

Purpose: We report our clinical experience with anterior diagonal iliac osteotomy in 10 patients who underwent surgery for bladder exstrophy. Technique and long-term results are discussed.

Materials and Methods: A total of 10 boys 1 month to 9 years old with bladder exstrophy underwent this procedure during a 2-year period.

Results: None of the patients had bladder closure dehiscence or prolapse after the operation. There were neither infectious complications nor injury to the vessels or nerves in any case. Blood loss was minimal for anterior diagonal iliac osteotomy. The only significant complication in our series was the polypropylene erosion of the urethra, necessitating endoscopic removal in 1 patient 1 month postoperatively. All patients had wide diastasis of the pubis preoperatively (average pubic distance 53.3 cm., average pubic ratio 0.9). At surgery suturing the symphysis after bilateral osteotomy resulted in a satisfactory symphyseal approximation and tension-free closure of the abdominal wall was easily achieved in all cases. Radiological studies at a mean followup of 34.6 months (range 14.8 to 49.5) revealed significant recurrent diastasis of the pubic bones in all but 1 patient in whom bone grafts were applied between the iliac fragments. Mean interpubic distance was 42 cm. and mean pubic ratio was 0.6 at long-term followup.

Conclusions: Diagonal osteotomy may correct the principal bony deformity in exstrophy and enables initial symphyseal approximation. Pubic diastasis may recur, probably due to opening forces generated by soft tissue elements of the pelvis.

KEY WORDS: osteotomy; bladder exstrophy; abnormalities; bone, pubic

Patients with bladder exstrophy present with widening of the anterior bony pelvis caused by outward rotation of the innominate bones along each sacroiliac joint and outward rotation or eversion of the pubic rami at their junction with the ischium and ilium.¹ To date various types of osteotomies through the posterior or anterior pelvic ring have been performed to facilitate the approximation of pubic bodies and primary closure of the soft tissue defect.^{2–7} Different success rates at various centers have been published, and some even suggest no osteotomy.^{8,9} Recently a new anterior mid iliac diagonal osteotomy has been proposed.^{10,11} However, there is little information on the long-term results of this procedure in the relevant literature. We performed anterior diagonal iliac osteotomy in 10 consecutive cases of bladder exstrophy in 2 years. We determined the efficacy and long-term results of anterior diagonal iliac osteotomy in children with bladder exstrophy.

MATERIALS AND METHODS

Between January 1994 and December 1995 anterior diagonal iliac osteotomy was performed in 10 boys 1 month to 9 years old (mean age 3.4 years) with bladder exstrophy at our institution. Other surgical procedures performed at osteotomy included primary closure in 6 cases, bladder neck reconstruction in 5, epispadias repair in 5, ureteroneocystostomy in 4 and bladder augmentation in 1. Three patients had previously undergone unsuccessful posterior pelvic osteotomy (see table).

Anterior diagonal iliac osteotomy was performed through the same incision as exstrophy closure. Each side was exposed simultaneously and there was no need to turn patients

from supine to prone intraoperatively. Through a vertical midline skin incision the abdominal skin with subcutaneous tissue was widely mobilized laterally, exposing the anterosuperior iliac spines and iliac crests on each side. The perichondrium on the iliac crest was incised longitudinally. Through this incision the perichondrium was elevated from the periosteum on the medial and lateral sides of the innominate bones by gauze sponges. The greater sciatic notch was exposed and curved elevators were placed to isolate the contents of the sciatic foramen. A Gigli saw was passed through the sciatic notch on the leader of a right angle clamp. Diagonal osteotomy was performed from the sciatic notch to 1 to 2 cm. posterior to the anterosuperior iliac spine using the Gigli saw in infants (fig. 1). In older children osteotomy was done with a thin osteotome following holes created by a drill. The iliac wing on either side was exposed and osteotomy was done in the same manner.

Bone grafts were applied between the iliac fragments in the last patient in our series. After bilateral diagonal osteotomy of the iliac wings 2 No. 1 nylon horizontal mattress sutures were placed through all layers of the pubic symphysis on each side. While compressing the pelvis and rotating the legs inward, sutures were tied anteriorly. Complete symphyseal approximation with minimal tension was achieved in all cases. Postoperatively patients were immobilized by a long leg plaster cast to a position in which the hips had complete adduction, 45 to 60 degrees of flexion and 10 to 15 degrees of internal rotation. The cast was maintained for 6 to 9 weeks.

All patients underwent preoperative and postoperative x-rays of the pelvis to measure the interpubic distance, defined as the distance between the medial cortex of 2 pubic bodies on an anteroposterior pelvic radiogram. To standard-

Patient demographics and pubic measurements before and after osteotomy

Pt. No. — Age	Additional Surgery	Preop.		Postop. 1			Postop. 2		
		Pubic Distance (cm.)	Pelvic Ratio	Mos. Followup	Pubic Distance (cm.)	Pelvic Ratio	Mos. Followup	Pubic Distance (cm.)	Pelvic Ratio
1 — 1 Yr.	Primary closure	25	0.8				14.8	35	0.5
2 — 1.5 Yrs.	Primary closure	50	1.0	1.9	30	0.6	49.5	39	0.6
3 — 1.5 Yrs.	Primary closure	50	1.0	1.6	25	0.5	40.3	33	0.5
4 — 1 Mo.	Primary closure	32	0.8				23.1	43	0.8
5 — 4 Yrs.	Primary closure + bladder neck reconstruction	55	1.0	1.5	32	0.6	43.4	43	0.7
6 — 9 Yrs.	Bladder neck reconstruction, epispadias repair + ureteroneocystostomy	80	1.0	1.6	25	0.4	34.1	40	0.5
7 — 4 Yrs.*	Bladder neck reconstruction, epispadias repair + ureteroneocystostomy	49	0.9	2.0	30	0.5	36.0	32	0.4
8 — 5 Yrs.*	Bladder neck reconstruction, epispadias repair, ureteroneocystostomy + bladder augmentation	70	1.0	2.2	62	0.9	34.1	65	0.9
9 — 2 Yrs.*	Bladder neck reconstruction, epispadias repair + ureteroneocystostomy	62	0.9	1.0	52	0.7	34.1	65	0.9
10 — 6 Yrs.†	Primary closure + epispadias repair	60	0.9	1.5	33	0.5	37.0	25	0.3
Mean 3.4		53.3	0.9	1.7	36	0.6	34.6	42	0.6

* Previously unsuccessful posterior iliac osteotomy.

† Bone grafts were applied between the iliac fragments.

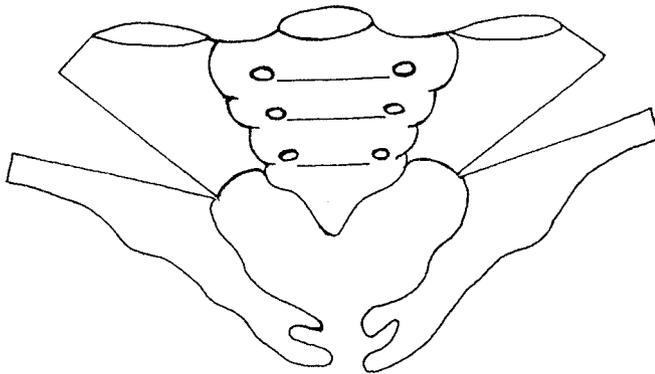


FIG. 1. Anterior diagonal iliac osteotomy

ize measurements and avoid misinterpretations due to variations in patient size and radiographic techniques the degree of pubic diastasis was also quantified by the pelvic ratio, calculated using the formula, interpubic distance/width of the sacral bone, as suggested by Schmidt et al.¹² At a mean followup of 34.6 months (range 14.8 to 49.5) long-term results were evaluated.

RESULTS

Surgical course and convalescence were uneventful in all cases. None of the patients had bladder closure dehiscence or prolapse after the operation. There were no infectious complications and no injury to the vessels or nerves. Bleeding from major vessels did not occur in any patient and blood loss was minimal for anterior diagonal iliac osteotomy. The only significant complication in our series was polypropylene ero-

sion of the urethra, necessitating endoscopic removal in 1 patient 1 month after the operation.

All patients had wide diastasis of the pubis preoperatively (average 53.3 cm., pubic ratio 0.9, see table and fig. 2, A). At surgery suturing the symphysis after bilateral osteotomy resulted in a satisfactory symphyseal approximation and tension-free closure of the abdominal wall was easily achieved in all patients. Radiological studies at a mean followup of 34.6 months (range 14.8 to 49.5) revealed significant recurrent diastasis of the pubic bones in all but 1 patient in whom bone grafts were placed between the iliac fragments. Mean interpubic distance was 42 cm. and mean pubic ratio was 0.6 at long-term followup (see table, and fig. 2, B and C). No clinical symptom attributable to this late recurrent diastasis was noted in any patient. We did not assess continence status in regard to osteotomy in our study because the number and type of concomitant procedures, including bladder neck repair, were not standard in all cases.

DISCUSSION

Initially performed in the mid 1950s to facilitate bladder closure, pelvic osteotomy has many advantages.⁶ Bilateral iliac osteotomies in bladder exstrophy increase pelvic mobility and enable symphyseal approximation, decreasing stress on the midline abdominal closure. The firm anterior pelvic ring prevents dehiscence, infection and prolapse of the reconstructed bladder, and facilitates urethral suspension. Osteotomy also results in penile lengthening by decreasing the interpubic distance and bringing the corpora closer together. Moreover, approximation of the levator ani around the urethra may aid in later voluntary urinary control.^{3,5,13-17}

Various types of osteotomies have been proposed to facilitate approximation of the pubic bodies. Posterior iliac osteot-



FIG. 2. Case 7. Plain x-ray shows pubic distance. A, before osteotomy. B, 2 months postoperatively. Arrowheads indicate osteotomy lines. C, 3 years postoperatively.



FIG. 3. Case 10 in which bone grafts were placed between iliac fragments. Plain x-ray reveals pubic distance. A, before osteotomy. B, 1.5 months postoperatively. C, 3 years postoperatively

omy was traditionally performed in the majority of patients in the past. This procedure requires 1 or 2 additional posterior incisions and repositioning the patient from supine to prone during surgery, increasing operative time. In addition, others reported dissatisfaction with poor pelvic mobility and delayed or poor union of the ilium.^{5, 13, 16, 18}

Dissatisfaction with posterior iliac osteotomies has resulted in attempts to search for alternative osteotomy techniques. Anterior approaches, such as anterior innominate osteotomy and superior pubic ramus osteotomy, have become popular in recent years.^{3-5, 13} In 1994 McKenna et al suggested a new anterior mid iliac diagonal osteotomy that provides more functional pelvic closure.^{10, 11} They performed various osteotomies in a pelvic exstrophy model based on data from 3-dimensional computerized tomography of a 3-year-old patient with classic bladder exstrophy. After comparing results they suggested that anterior diagonal iliac osteotomy provides the best symphyseal approximation because it best corrects ilial bone flattening with the most symmetrical pelvic reconstruction. Similar results were reported in 1985 in 7 anterior iliac osteotomies.^{19, 20} To our knowledge that report in Turkish represents the initial original description and clinical application of the anterior diagonal iliac osteotomy technique. We found no published study providing data on the long-term results of anterior diagonal iliac osteotomy. Published studies clearly demonstrate the advantages and superiority of anterior diagonal iliac osteotomy but these reports were not followed by larger series and long-term results in succeeding years.

We present our clinical experience with and long-term results of anterior diagonal iliac osteotomy in 10 patients with bladder exstrophy. Our clinical observation is that anterior diagonal iliac osteotomy may be easily performed at primary closure, bladder neck reconstruction and/or bladder augmentation with a low complication rate. Early postoperative complications, such as wound infection and dehiscence, that were reported at various rates in various series, have not developed in our patients. The procedure is more comfortable for the surgical team than posterior iliac osteotomy since it does not require turning the patient during surgery. The only significant complication was polypropylene erosion of the urethra. However, this problem did not interfere with separation of the pubic bodies and no discernible recurrent diastasis was observed more in this case than the other in our series.

Anterior diagonal iliac osteotomy was performed through the thinnest portion of the iliac wings, providing great pelvic mobility and better pubic approximation. Therefore, a satisfactory symphyseal approximation with minimal tension and complete abdominal wall closure were achieved in all cases. However, significant diastasis recurred in 9 of our 10 patients at a mean followup of 3 years, mostly during the initial 2 months postoperatively. In only 1 patient with bone grafts

did recurrent diastasis progression stop after month 2 postoperatively and pelvic x-rays revealed a significant progressive decrease in the interpubic distance by that time (fig. 3). We think that bone grafts placed between the iliac fragments prevented diastasis recurrence by resisting the opening forces generated by the pelvic muscles and ligaments, which force the separated iliac fragments to rejoin. Moreover, the bone grafts stabilized the iliac fragments and maintained the optimum pelvic diameter in this patient, resulting in compensation of the intrapelvic volume distress in the long term and preventing the progression of recurrent diastasis. On the other hand, the decreased interpubic distance on x-ray may have been due to progressive ossification of the pubic bones with increasing patient age. We used bone grafts only in the last patient of our series and, therefore, do not have enough data to make objective comments on the beneficial effects of bone grafts for preventing diastasis recurrence. However, the marked decrease in the interpubic distance in that patient encouraged us to use bone grafts routinely in the future.

An important point that should be kept in mind is the technical difficulty of anterior diagonal osteotomy when incising and separating the deep layer of the periosteum. Insufficient release of the iliac bones may lead to repeat separation of the pubic symphysis. However, we do not think that this situation occurred in our patients since we achieved complete symphyseal approximation in all after osteotomy. Furthermore, in the majority of our patients we performed osteotomy in a retrograde fashion from the sciatic notch to 1 to 2 cm. posterior to the anterior superior iliac spine using a Gigli saw. Thus, we believe that it is impossible for the deep layer of periosteum to remain unseparated using this technique.

Although diagonal osteotomy allows initial symphyseal approximation and facilitates abdominal wall closure, pubic diastasis may recur, probably due to opening forces generated by the pelvic muscles and ligaments, and intrapelvic volume distress caused by the pelvic organs. Pubic diastasis recurred in the majority of our patients at a mean followup of 3 years but did not affect final bladder and anterior abdominal wall reconstruction. Thus, anterior diagonal iliac osteotomy remains our method of choice for bladder exstrophy repair to produce a tension-free symphyseal approximation. This approximation provides the pelvic stability necessary for the healing of soft tissues in the early postoperative period, especially the bladder, urethra and anterior abdominal wall. Bone grafts placed between the iliac fragments may prevent diastasis recurrence and provide a more favorable morphological outcome.

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