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# VAGINAL WALL SLING

SHLOMO RAZ, ANDREW L. SIEGEL, JULIE L. SHORT AND JEFFREY A. SYNDER

*From the Division of Urology, University of California School of Medicine, Los Angeles, California*

ABSTRACT

We describe a new technique for the treatment of urinary incontinence due to intrinsic sphincteric damage in which a sling constructed from vaginal wall is used to provide compression and support of the urethra. A rectangular island of in situ anterior vaginal wall underlying the urethra and bladder neck is developed, the 4 corners are anchored with polypropylene sutures and a ligature carrier is used to transfer the sutures to a suprapubic location. An anterior vaginal wall flap proximal to the island is advanced to cover the island. When the sutures are tied the resulting sling will support the urethra and increase urethral resistance by compression, restoring continence. The advantages are its simplicity, need for only a small incision, short operative time and hospital stay, and reliance on healthy, well vascularized, in situ tissue. Continence has been achieved in 29 of 32 cases. All patients voided spontaneously except for those with neuropathic urethral incompetence who required self-catheterization. (*J. Urol., 141: 43–46, 1989*)

Urinary incontinence is a significant problem involving more than 20 million Americans, prompting more than half of nursing home admissions, and fostering a billion dollar pad and appliance industry.[1] Urinary incontinence (involuntary loss of urine per urethram) can be related to bladder or sphincteric dysfunction. Bladder-related incontinence may be due to instability, changes in compliance or incomplete emptying. Sphincteric-related incontinence is caused by anatomical malposition of an intact sphincter unit (anatomical incontinence) or intrinsic sphincteric damage, when with or without an accompanying anatomical abnormality the urethra and bladder neck are no longer functioning as a sphincteric unit.

Anatomical incontinence can be approached with excellent success by any of the retropubic or transvaginal procedures that restore the proximal urethra and bladder neck to a high, fixed retropubic position. However, when the sphincter is damaged intrinsically mere restoration of position will fail to cure the problem, which necessitates increasing urethral resistance. Aside from artificial urinary sphincter and periurethral polytetrafluoroethylene (Teflon) injections, a common surgical alternative is the pubovaginal sling procedure. We propose a novel approach to this problem using an in situ, well vascularized island of anterior vaginal wall to provide urethral compression and suspension.

## MATERIALS AND METHODS

Between December 1985 and June 1987, 32 patients were selected for this procedure because of intrinsic urethral incompetence. Of the patients 26 had sphincteric incontinence after a failed stress incontinence operation and 6 had neurogenic sphincteric incontinence. These 32 patients represented less than 10 per cent of the total population of patients with stress urinary incontinence. Followup has ranged from 10 to 28 months.

Patient age in the neurogenic group ranged from 7 to 54 years. Of the 6 patients 5 were myelodysplastic girls with sphincteric incompetence and the adult had urethral incompetence after a back operation that damaged the sacral arc. In this group the goal of surgery was to create urinary retention by increasing urethral resistance and to initiate a program of self-catheterization. The myelodysplastic patients had failed a trial of pharmacological manipulation, self-catheterization, enlargement cystoplasty and abdominal bladder neck suspension. Despite compliant, capacious, low pressure urinary reservoirs the patients remained incontinent because of severe sphincteric incompetence.

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Of the 26 patients with nonneurogenic incontinence a total of 97 prior incontinence procedures had been performed. Patient age ranged from 27 to 82 years. Two patients had pelvic fractures and failed conventional bladder neck suspension (Marshall-Marchetti-Krantz). Two patients had pelvic irradiation for uterine carcinoma, and failed anterior colporrhaphy and Burch colposuspension. A total of 22 patients had failed a prior operation for anatomical-related stress incontinence. One patient had a contracted bladder and an incompetent bladder neck requiring augmentation cystoplasty at the time of the sling procedure.

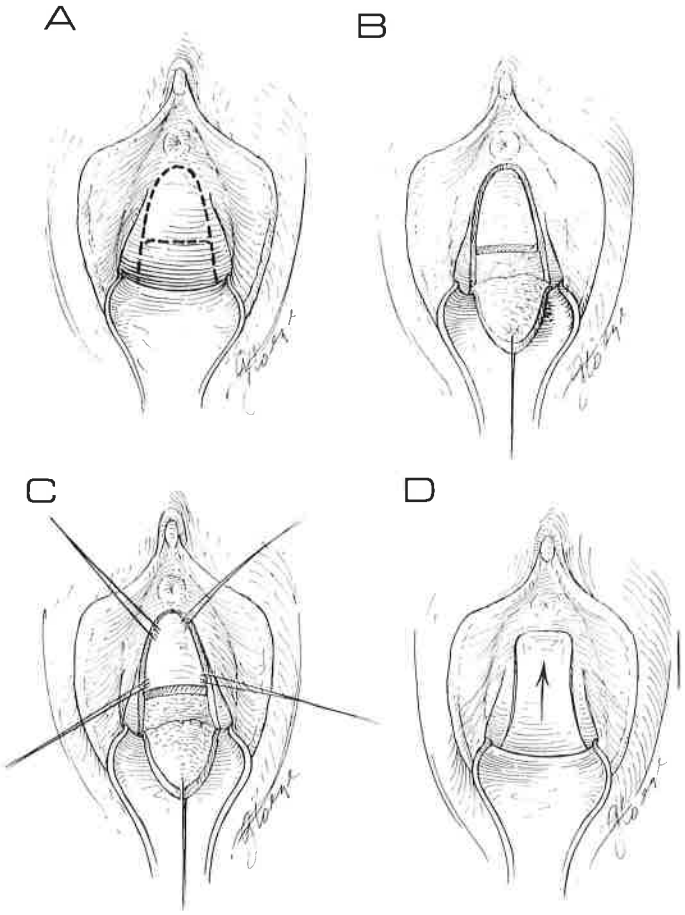
All patients were evaluated clinically, urodynamically and radiologically. History typically revealed severe stress urinary incontinence, with leakage of urine with the patient in the supine and upright positions. Palpation of the anterior vaginal wall often demonstrated scarring and induration from previous surgical attempts to correct the incontinence. Urodynamically, the loss of urine per urethram during an elevation in abdominal pressure without a true detrusor contraction was observed. Uroflowmetry often demonstrated superflows because of the lack of urethral resistance. Occasionally, an obstructive pattern was demonstrated that was probably due to urethral scarring. Urethral pressure profilometry, although of questionable clinical use, typically demonstrated low values. Urethroscopy typically revealed an open, incompetent bladder neck. A cystogram under fluoroscopy demonstrated that the bladder neck was open at all times (not only with stress maneuvers). The diagnosis of sphincteric incompetence was not made on the basis of any test alone but on the entire clinical picture in combination with urodynamic, endoscopic and radiological studies.

*Surgical technique.* The patient is placed in the full lithotomy position. After thorough vaginal, perineal and abdominal preparation standard draping, including rectal isolation, is performed. A weighted vaginal speculum is placed, labial retraction sutures are used, and a suprapubic tube and urethral catheter are placed. Saline infiltration of the anterior vaginal wall with a 25 gauge needle facilitates dissection. An inverted U incision is made with its apex just proximal to the urethral meatus and its base extended several centimeters proximal to the bladder neck. Lateral dissection is performed along the glistening white periurethral fascia to the pubic bone. Sharp and blunt dissection is used to perforate the endopelvic fascia and enter the retropubic space. The urethra is mobilized completely by freeing the lateral attachments of the endopelvic fascia from

the level of the pubis to the ischial tuberosity. The midline tissue over the urethra is left intact.

A transverse incision at the level of the bladder neck is made joining the lateral borders of the original incision (part *A* of figure). This creates a rectangular island of anterior vaginal wall that underlies the bladder neck and urethra, retains its own vascular supply and will function as the sling. The size of this island is tailored easily to the length and caliber of the urethra. The proximal vaginal wall then is undermined to create a flap that will be advanced to cover the island at a later step (part *B* of figure). The 4 corners of the rectangle then are anchored with individual sutures of No. 1 polypropylene applied in helical fashion (part *C* of figure). The sutures at the level of the bladder neck and at the distal corners of the rectangle incorporate the entire vaginal wall, the former including the epithelium, pubocervical fascia and endopelvic fascia, and the latter including the epithelium and periurethral fascia.

A small transverse skin incision is made just superior to the pubic symphysis and is extended down to the rectus fascia. A double-pronged ligature carrier is used to transfer individually the polypropylene sutures from the vagina to the suprapubic region. A finger in the retropubic space during transference prevents inadvertent penetration of the bladder and urethra. The double-pronged carrier will permit the sutures to be tied over a 1 cm. segment of rectus fascia. Indigo carmine is administered intravenously, and cystourethroscopy is performed to ensure that the urethra and bladder neck are compressed and suspended effectively when minimal tension is placed on the suspension sutures. Endoscopic examination also will confirm that the bladder and urethra have not been penetrated by a suture, and that there is efflux of urine from each ureteral orifice.




*A*, inverted U vaginal incision with transverse incision at level of vesical neck to create island. *B*, undermining of vaginal wall proximal to island to create flap. *C*, anchoring of 4 corners of island with individual polypropylene sutures applied in helical fashion. *D*, proximal vaginal wall flap advanced over island to cover sling.

The proximal vaginal wall flap, previously mobilized and developed, then is advanced over the sling to provide an epithelial cover and restore the integrity of the vagina, using a 2-zero polyglactin suture (part *D* of figure). All polypropylene sutures are tied independently, and then to each other and across the midline. The vaginal wall island, thus, functions to sling the urethra and bladder neck. The suprapubic incision is repaired with a running subcuticular 4-zero polyglactin suture and a vaginal pack impregnated with antibiotic ointment is placed. The urethral catheter, vaginal packing and intravenous line are removed 1 day postoperatively. The patient is instructed on how to manage the suprapubic tube and she generally is discharged from the hospital 2 days postoperatively . When spontaneous voiding resumes and when the post-void residual becomes negligible the suprapubic tube is removed in the office.

## RESULTS

The objective and subjective results of the sling procedure were defined as excellent—no pads, medications or incontinence, very good—no pads or medications and rare incontinence, improved—occasional pads and medication, and some incontinence but much better than preoperatively, and failed—pads, medications, unimproved or worse. All 6 patients (100 per cent) with neurogenic urethral incompetence had excellent results after the vaginal sling procedure and all required self-catheterization.

The 26 patients with nonneurogenic urethral incompetence underwent the vaginal sling procedure. Clinical and urodynamic evaluation demonstrated preoperative detrusor instability in 6 patients (23 per cent). Two patients (8 per cent) had pelvic radiation, 2 (8 per cent) had a pelvic fracture and 22 (85 per cent) had had prior attempts at repair of the incontinence. Results were excellent in 20 patients (77 per cent), very good in 2 (8 per cent), improved in 1 (4 per cent) and failed in 3 (12 per cent). The latter 4 patients (improved or failed) subsequently underwent periurethral polytetrafluoroethylene injection with 1 cure, 1 improvement and 2 failures. All patients with nonneurogenic urethral incompetence ultimately voided spontaneously and none required permanent self-catheterization. One patient required prolonged self-catheterization for 9 months before resumption of spontaneous voiding. In short-term followup de novo instability was identified in 6 of the 26 patients (23 per cent). This was minimally symptomatic with mild frequency and urgency, and generally responded satisfactorily to anticholinergic medication. After 6 months de novo instability was identified in 4 patients (15 per cent).

The vaginal sling procedure failed to correct the incontinence in 2 of 32 patients. One patient had had 8 prior anti-incontinence procedures, and a periurethral and pelvic abscess from an eroded bolster used in a Stamey procedure. She also suffered from severe atrophic vaginitis. The vaginal sling failed 2 months postoperatively and she ultimately underwent cecocystoplasty, a pubovaginal sling procedure and colpocleisis. The other patient had had 2 prior urethral diverticulectomies with loss of urethra and anterior vaginal wall impairment. She failed in the immediate perioperative period and ultimately underwent creation of a neourethra using an intestinal segment.

## DISCUSSION

Intrinsic sphincteric incompetence most often is associated with multiple failed anti-incontinence procedures resulting in a fixed open urethra in a normal anatomical position. Other causes are radiation, pelvic fracture and neuropathic urethral dysfunction, as well as direct damage to the urethral mucosal sphincter, urethral musculature or periurethral tissues, including urethral ischemia and damage to the pelvic nerves subserv-

ing urethral function. The mucosal sphincter refers to the mucosal seal effect created by the convolutions and infoldings of the urethral mucosa surrounded by a rich, spongy, submucosal vascular plexus encased in a fibroelastic and muscular tissue. The clinical presentation is that of severe stress incontinence with leakage of urine with the patient in the upright and supine positions. Urethroscopy demonstrates an open bladder neck in the absence of a detrusor contraction. The endoscopic appearance is that of a "leadpipe" and "pipestem" urethra, denoting the rigidity and scarring. A urethral pressure profile will demonstrate low urethral closing pressures.

Treatment of urethral sphincteric incompetence entails increasing urethral resistance via compressive slings, bladder neck reconstruction,[2] periurethral polytetrafluoroethylene injections[3] and the artificial urinary sphincter.[4] The sling procedures are relatively simple and do not incorporate a prosthesis, providing some theoretical advantages over the other procedures. The myriad of sling procedures all share the restoration of continence by external urethral compression. The procedures vary in the choice of tissue used to apply the compression and the tissue to which it is anchored. The sling techniques reported in the early 1900s used muscle in the hope that through contractility restoration of sphincter-like activity would occur. However, these procedures were doomed to failure because of neurovascular damage resulting from mobilization. Aldridge summarized the evolution of the sling technique from a historical perspective with gracilis muscle used in 1907, pyramidalis in 1910, levator ani in 1911, and pyramidalis muscle and fascia in 1914.[5] In 1917 Stoeckel added the modification of vesical neck plication. Rectus muscle and fascia were used in 1923, bulbocavernosus muscle and fat in 1929, and fascia lata in 1933.

In 1942 Aldridge reported on rectus fascial strips left attached to the midline and united under the bladder neck, taking advantage of the favorable anatomical relationship between the rectus muscle and urethra.[5] The Aldridge procedure was a classical technique that remained in vogue for many years. McLaren reported 87 per cent short-term and 71 per cent long-term cure rates with the Aldridge technique in 48 patients.[6] In 1968 Moir described a modification in which a synthetic material, polydioxanone mersilene gauze, is used to provide a broad hammock-like base of support for the bladder neck and urethra.[7] Polytetrafluoroethylene tape,[8] Marlex propylene mesh,[9] dermal grafts,[10] lyophilized dural bands[11] and the round ligament[12,13] have been used as compressive slings. In 1984 Poliak and associates reported on the use of palmaris longus tendon to sling the bladder neck to Cooper's ligament.[14] In 1962 Narik and Palmrich described a variation on the Aldridge theme in which strips of external oblique aponeurosis were left attached to the pubic tubercle and united under the bladder neck, with 49 of 51 patients having good results.[15]

In 1969 Low used fascia lata placed in pubovaginal fashion to create urethral compression with resolution of the incontinence in 41 of 43 patients.[16] McGuire and Lytton used a pubovaginal autogenous sling consisting of a 1 × 12 cm. strip of rectus and external oblique fascia with satisfactory results in 50 of 52 patients.[17] The failures had documented high residual volumes and responded to a secondary procedure to reduce sling tension. It is noteworthy that instability disappeared postoperatively in 20 of 29 patients. In a recent update McGuire and associates reported an initial success rate in 67 of 82 patients.[18] Eight failures were due to a hyperactive detrusor and 7 patients were regarded as operative failures. Complications encountered were prolonged self-catheterization and occasional de novo instability.

The principle used to cure incontinence due to intrinsic sphincteric damage is to increase urethral resistance by providing urethral compression. The plethora of procedures described in the literature attest to the lack of an ideal method, which should be simple, reliable and reproducible in the hands of any urologist, and incur minimal patient morbidity and a short hospital stay. Autogenous tissue seems to offer a theoretical advantage over any synthetic material because of the lessened risk of infection or inflammation associated with the absence of a foreign body. Our method is unique in that it requires no extravaginal harvesting incision, thus, minimizing morbidity, causing much less postoperative pain and hastening recovery and discharge of the patient from the hospital. The anterior vaginal wall is suited ideally because of its anatomical relationship to the urethra, which allows for the sling to be tailored precisely to the width and length of the urethra. The fact that the vascular supply to the sling is left intact confers an obvious advantage.

The ideal sling should result in a broad base of urethral support in which pressure is distributed evenly, minimizing the risks of ischemia, pressure necrosis, fistula or erosion. A disadvantage of pubovaginal sling procedures is the potential for the sling to become a narrow cord causing focal compression. Our sling procedure results in even distribution of pressure, since the island is in situ and compresses the entire length and width of the urethra. Our procedure requires only lateral dissection, and no dissection directly under the bladder neck and urethra, which minimizes the risk of inadvertent urethral or bladder injury. Dissection in the plane between the anterior vaginal wall and urethra is obviated, as is the mechanical problem of interposing bulky tissue between the urethra and vagina.

Any sling technique involves risks of delayed voiding, obstructive and irritative voiding symptoms, de novo instability, bladder or urethral injury and erosion. Since some patients before the sling void by straining and not by a detrusor contraction they may have difficulty voiding postoperatively and they must be encouraged to void by detrusor contraction.[17] The onset of de novo instability (4 of 26 patients after 6 months) probably is related to the relative degree of obstruction created by the sling. Instability causes mild irritative voiding symptoms and generally is responsive to anticholinergic therapy. Potentially, our procedure could result in vaginal foreshortening although we have not found this to be a problem to date.

Our sling procedure is relatively contraindicated in a sexually active woman with a short vagina. However, in a sexually inactive woman with a short vagina the entire anterior vaginal wall can be used to construct the sling (we used this option in 2 patients). Patients have not encountered problems with intercourse after our procedure. Another contraindication is senile atrophic vaginitis, which will not provide a vaginal wall of sufficient tissue integrity and tensile strength to be used as a sling. This was the situation in 1 of our failures. If recognized preoperatively this problem may be circumvented with the administration of vaginal estrogen preparations. We have encountered no problems with burying the island of vaginal epithelium. However we recognize the potential for cyst formation. Long-term followup is unavailable to date but our short-term results are encouraging. It would seem that failures generally present early and if a patient remains continent after 6 months they only rarely will fail later. Periurethral polytetrafluoroethylene injections have proved to be a useful adjunct when the vaginal sling procedure results in only marginal improvement.

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