Restoration of Posterior Aspect of Rhabdosphincter Shortens Continence Time After Radical Retropubic Prostatectomy

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Purpose: Prolonged postoperative incontinence is a major drawback of RRP. Age, scars in the rhabdosphincter, nonnerve sparing surgery and postoperative sphincter insufficiency can cause temporary or definitive urinary incontinence. We believe that sphincter deficiency is the main cause of early incontinence. Urinary leakage results from the shortening of anatomical and functional sphincter length due to caudal retraction of the urethral sphincteric complex and disruption of the median posterior fibrous raphe. We describe a modification of the Walsh RRP that overcomes caudal retraction, reconstructs the posterior fibrous raphe and decreases time to continence. The primary study end point was early continence rate assessment. Long-term continence (1 year) and erectile function assessment were secondary end points.

Materials and Methods: To avoid caudal retraction of the urethral sphincteric complex, before completing the vesicourethral anastomosis the posterior semicircumference of the sphincter is joined to the residuum of Denonvilliers' fascia and fixed to the posterior bladder wall 1 to 2 cm cranial and dorsal to the new bladder neck. Vesicourethral anastomosis is subsequently performed with care taken not to involve the neurovascular bundles. A total of 161 patients with clinically confined disease underwent modified RRP (group 1). They were compared with a historical series of 50 patients who underwent standard RRP (group 2). Early continence was defined as no pad use but patients using 1 diaper were also considered continent. Continence, assessed prospectively as the number of pads daily, was evaluated 3, 30 and 90 days, and 1 year after catheter removal. The continence state was assessed by a multivariate logistic model. Erectile function was evaluated using the International Index of Erectile Function questionnaire preoperatively and after 18 months in patients younger than 65 years who underwent nerve sparing surgery.

Results: In group 1, 116 (72%), 127 (78.8%) and 139 patients (86.3%) were continent 3, 30 and 90 days after catheter removal compared with 7 (14%), 15 (30%) and 23 (46%), respectively, in group 2. One-year continence rates were 96% and 90%, respectively. Erectile function was similar in groups 1 and 2 (46% and 42%, respectively). Multivariate analysis showed that continence was significantly influenced by operation type, stage and patient age.

Conclusions: Careful reconstruction of the posterior aspect of the rhabdosphincter markedly shortens time to continence.

Key Words: prostate, prostatectomy, urinary incontinence, prostatic neoplasms, bladder

Prolonged postoperative incontinence is a major drawback of RRP irrespective of the surgical technique used and it is considered by patients more bothersome than impotence. Most investigators agree that the condition is stress incontinence due to insufficiency of the urethral sphincter, which is decreased by the operation. Aging and scars in the urethral sphincter as well as nonnerve sparing surgery are other causes of postoperative incontinence. Detrusor muscle dysfunction may aggravate incontinence but it is rarely its primary cause. Hammerer and Huland noted shortened functional length, and decreased urethral closing pressure and maximum urethral pressure in continent patients. These data suggest that sphincter deficiency may be considered one of the most relevant causes of postoperative incontinence.

Time to continence cannot be predicted and most groups consider that a definitive evaluation of urinary function should be performed at 12 months or later. Although most patients eventually recover continence, the period of incontinence is poorly tolerated and quality of life is compromised. We describe a modification of the Walsh RRP that is designed to decrease time to continence.

MATERIALS AND METHODS

Surgical Anatomy of the Urethral Sphincteric Complex

Embryological and anatomical studies show that the urethral rhabdosphincter is a cylindrical structure surrounding the urethra and extending vertically from the perineal membrane to the base of the bladder. Its muscle fibers insert cranially into the apex and anterior face of the prostate gland to merge with fibers of the detrusor muscle and cau-
daily into the perineal fascia. This description emphasizes the vertical development of the muscle, superseding the idea of a mainly horizontal development embodied in the term urogenital diaphragm.9–11

The anterior and lateral walls of the rhabdosphincter are thick and rich with striated muscle fibers. The posterior wall contains little or no muscle.9,10,12,13 It consists mainly of fibrous connective tissue. The connective tissue of the posterior rhabdosphincter is contiguous with the posterior median raphe, which connects the rhabdosphincter to the perineal membrane caudally and to Denonvilliers’ fascia at the apex and posterior aspect of the prostate cranially.

Denonvilliers’ fascia, the prostate dorsal aspect and the posterior median raphe with the connected rhabdosphincter dorsal wall form a unique musculofascial plate extending from the peritoneum of the pouch of Douglas to the perineal membrane and the central tendon of the perineum. The musculofascial plate is an important support structure in the pelvis that “appears to serve as a fixation point for the muscle fibers of the rhabdosphincter[ . . . ] The musculofascial plate is a dynamic suspensory system for the prostatomembranous urethra.”12

The musculofascial plate is sectioned during RRP and partly removed with the prostate and the part of Denonvilliers’ fascia covering the seminal vesicles. These changes have certain important functional consequences. 1) The urethral sphincteric complex loses its posterior cranial insertions into the prostatic apex and Denonvilliers’ fascia, resulting in loss of the relatively rigid posterior surface against which the anterolateral walls contract to close the urethra. 2) Due to elastic retraction of the urethral longitudinal smooth muscle the urethral sphincteric complex shortens and is displaced caudal, although anterior the puboprostatic ligaments restrain this displacement. This elastic shortening decreases the anatomical and functional length of the rhabdosphincter. 3) The perineum also prolapses caudally, dragging the urethral sphincteric complex with it. Surgeons are well aware of this and to retrieve the cut end of the retracted urethra they manually push the perineum in a cranial direction from the exterior.

The surgical procedure that we describe restores the anatomical and functional length of the rhabdosphincter and restores firm support for its posterior aspects by fixing the whole structure in its natural position, facilitating rapid recovery of function.

New Surgical Technique

The first part of the operation follows the Walsh procedure.8 After incising the pelvic fascia on each side the prostatic apex is prepared, leaving the puboprostatic ligaments in place. In select cases the neurovascular bundles are identified and detached from the apex. Thereafter the anterolateral walls of the rhabdosphincter and the anterior semicircumference of the urethra are sectioned. After the catheter in the urethra is located and severed the posterior wall of the urethra and the sphincter musculature that adheres to it posterior are sectioned. Before freeing the prostatic apex the posterior median raphe is carefully preserved, separating it from the neurovascular bundles and rectal fascia (fig. 1). The raphe is sectioned and marked with 2 polyglactin 3-zero sutures. The apex of the prostate is then free and prostatectomy proceeds in the retroprostatic plane.

Two modifications to the Walsh procedure8 are introduced, namely 1) reconstruction of the posterior musculofascial plate and 2) suspension of the urethral sphincteric complex from the bladder. The dorsal musculofascial plate is reconstructed by joining the posterior median raphe to the residuum of Denonvilliers’ fascia.

1) In detail, after the prostate, seminal vesicles and distal vasa deferentia are removed en bloc standard tennis racket reconstruction of the bladder neck is performed.8 Before proceeding to vesicourethral anastomosis the posterior median raphe is fixed to the residual Denonvilliers’ fascia using the 2 previously placed marking sutures (fig. 2). By doing this the posterior wall of the sphincter is elongated cranially. The urethral circumference is not involved by these sutures.

2) To suspend the urethral sphincteric complex from the bladder the posterior median raphe joined to Denonvilliers’ fascia is now attached to the posterior bladder wall with 2 sutures applied about 1 to 2 cm cranial and dorsal to the new bladder neck. Thus, the dorsal aspect of the bladder is used as the new cranial insertion of the sphincter and posterior median raphe, serving as an anchor for sphincter fixation (fig. 3).

Subsequently the new bladder neck is anastomosed to the urethra with 6 to 8 polyglactin 3-zero sutures. The anterior sutures include the puboprostatic ligaments, and the posterior sutures join the urethra to the new bladder neck without involving the posterior median raphe (fig. 3). A 20Fr Foley catheter is inserted and the operation is completed by drainage insertion and abdominal wall closure. The catheter is removed 5 to 6 days after the operation, following cystography.

Patients

From February 2000 to February 2003, 161 consecutive patients with prostate cancer (group 1) underwent modified RRP and were prospectively evaluated. A total of 50 consec-
utive patients (group 2) treated from November 1998 to January 2000 underwent the unmodified Walsh RRP and served as the historical control group. Table 1 lists the characteristics of the 2 groups. In groups 1 and 2 the 44 and 25 patients, respectively, were 65 years or younger, had PSA 20 ng/ml or less and clinical stage not greater than T2, and underwent unilateral or bilateral nerve sparing RRP.

Study End Points
The primary end points were the percent of patients regaining urinary continence 3, 30 and 90 days after catheter removal. Early continence was defined as no pad use. Moderate incontinence was defined as 2 pads used per 24 hours and severe incontinence was defined as the use of more than 2 pads per 24 hours. Some patients who were warned before surgery of the risk of incontinence and were fearful of leakage used a single diaper the first days after catheter removal for minimal leakage (a few drops) or psychological support. These patients were also considered continent. Urinary control was evaluated by an independent interviewer. The interviewer assessed continence 3 days after catheter removal with a patient interview and a 24-hour pad test. Continence at 30 and 90 days, and every 3 months thereafter were evaluated with a telephone interview according to the International Consultation on Incontinence Questionnaire–Short Form questionnaire.

Secondary end points were long-term continence (1 year) as well as erectile function in patients who underwent a nerve sparing operation. Erectile function was assessed preoperatively and 18 months postoperatively by the International Index of Erectile Function questionnaire.

Data Collection and Statistical Analysis
At pathological examination Gleason score was assigned, and the number and site of positive margins were determined. All other data pertinent to outcome assessment were collected. Continuous quantitative data were recorded as the means, ranges and SD. Other data are expressed as proportions. The state of continence was assessed by a multivariate logistic model that included operation type, pathological stage, patient age and time to continence as independent variables. Pearson’s chi-square test was also used to assess differences between the groups using Stata®, release 8.0.

RESULTS
The 2 groups appeared similar in terms of Gleason score distribution, PSA and age (table 1). Stage differed significantly (Pearson’s chi-square test p < 0.001). As expected, followup was longer in group 2. Continence was regained in 116 (72%) of 161 patients in group 1 at 3, 30 and 90 days, respectively, following catheter removal. In group 2 continence was regained in 7 (14%), 15 (30%) and 23 (46%) of the 50 patients at 3, 30 and 90 days, respectively (table 2). The incidence of patient continence in

| Table 1. Characteristics of 161 patients who underwent modified radical prostatectomy and 50 consecutive historical controls who underwent unmodified Walsh radical prostatectomy |
|---------------------------------------------------|-------------------|-------------------|
| Group 1 | Group 2 |
| No. pts | 161 | 50 |
| Mean mos followup (range) | 19.6 (3–39) | 48.6 (40–54) |
| Mean age (range) | 66.56 (48–75) | 68.22 (57–73) |
| Mean ng/ml PSA (range) | 10.18 (1.2–62.6) | 8.78 (3.7–32.9) |
| No. stage (%): |
| pT2 | 118 (73) | 24 (48) |
| pT3 | 42 (26) | 22 (44) |
| pT4 | 1 (less than 1) | 4 (8) |
| No. Gleason score microfocus (%): |
| 2–4 | 12 (7.5) | 12 (24) |
| 5–7 | 118 (73.3) | 24 (48) |
| 8–10 | 15 (9.3) | 14 (28) |
| No. neoadjuvant hormone therapy (%) | 14 (8.7) | 0 |
group 1 was significantly greater than that in group 2 at the 3, 30 and 90-day assessments (p <0.001).

Multivariate logistic modeling of continence in relation to operation type, stage, patient age and time after catheter removal showed that time after catheter removal had a significant influence on the continence state, while early stage and young age were also significantly associated with earlier time to continence. In particular 76% of patients with pT2 and 60% with pT3-4 disease in group 1 were continent at discharge home compared with 29.1% (7 of 24) of those with pT2 and 0% of those with pT3-4 in group 2. One year after catheter removal the proportion of patients who had achieved continence in the 2 groups was similar, that is 99% of patients with pT2 and 89% of those with pT3-T4 in group 1 compared with 95% and 85%, respectively, in group 2 (table 2).

Erectile function was assessed in patients 65 years or younger who underwent nerve sparing surgery and had a followup of at least 18 months. In group 1, 11 of 24 patients (46%) and 8 of 19 (42%) in group 2 were potent spontaneously or with phosphodiesterase-5 inhibitors. Six group 2 patients were lost to followup.

On pathological examination 30 group 1 patients (18.6%) had positive margins, including 8 (5%) at the prostatic apex and 22 (13.6%) at other sites. Eight group 2 patients (16%) had positive margins, including 3 (6%) at the apex and 5 (10%) at other sites.

Bladder neck stricture occurred in 3 patients (1.9%) in group 1 at 4 months after catheter removal and in 2 (4%) in group 2 at 3 months. Acute urinary retention occurred in 6 (3.7%) group 1 and 1 (2%) group 2 patients 24 to 72 hours following catheter removal.

**DISCUSSION**

Krupsky et al,16 and Lepor and Kaci7 recently emphasized that marked variations in time to continence following RRP can partly be attributed to the definitions used. No leakage whatsoever or total urinary control may not always be the most appropriate definition of continence since in some patients some leakage may be acceptable, while in others minimal leakage may be a serious problem. In this study we included among continent patients those who used 1 diaper daily due to minimal leakage and those who believed that they needed the pad to give them confidence, although they were continent.

Many studies describe surgical techniques designed to shorten continence time after catheter removal. The best results seem to be achieved using procedures that preserve or reinforce the bladder neck,17,18 or spare the puboprostatic ligaments and incorporate them into the vesicourethral anastomosis for anterior suspension of the urethral sphincteric complex.19 Other groups emphasize the role of the urethral rhabdosphincter for continence.20–13 We modified the Walsh technique by reconstructing the musculofascial plate and restoring the connections of the residual Denonvilliers’ fascia to the posterior wall of the rhabdosphincter.

Our operation differs from that of Walsh, principally with regard to the way that the vesicourethral anastomosis is performed and how posterior wall sphincter fixation is achieved. The Walsh technique involves joining the new bladder neck, urethra and posterior sphincter wall with a single set of sutures. We attach the new neck to the urethra with sutures, while the posterior wall of the sphincter is joined to Denovilliers’ fascia with separate sutures applied in a plane different than that of the vesicourethral anastomosis. Urethropexy is completed by suspending the reconstructed musculofascial plate to the posterior bladder wall. We do not spare the bladder neck, but rather perform standard tennis racket reconstruction.

Patients undergoing this modified RRP achieved continence significantly earlier than those in the historical series. Of group 1 patients 72% had good continence 3 days after catheter removal and 86% had good continence 90 days after catheter removal. Most of the remaining 14% of patients achieved continence in subsequent months, that is 95% were continent at 1 year.

Greater care in preparing the structures of the prostatic apex may have contributed to our results but this cannot completely explain them. Better posterior support to the reconstructed urethral sphincteric complex, and its greater anatomical and functional length seem to be relevant reasons for our improved continence rates.

In laparoscopic prostatectomy the bladder is mobilized by freeing it anterior and posterior,20,21 so that distal prolapse of the rhabdosphincter is poorly corrected by the vesicourethral anastomosis and continence is regained more slowly than with a surgical approach. However, laparoscopy provides optimal visibility and the bladder neck is preserved. In certain cases it may be better to suspend the new bladder neck from the pelvic fascia, as recently proposed by Patel (personal communication), again to avoid dorsal and caudal prolapse of the vesicourethral anastomosis.

We did not verify on magnetic resonance imaging or urodynamic tests that the anatomical and functional length of the rhabdosphincter was indeed conserved in our series. As performed by Coakley et al,21 magnetic resonance imaging of the sphincter was not possible, while preoperative and postoperative measurement of urethral pressure is excessively invasive.

In a limited series of 14 patients the rhabdosphincter was studied using transrectal prostatic ultrasonography. We then measured preoperative sphincter length and compared it with postoperative length, finding it to be 87.8% and 55% in patients with and without striated sphincter reconstruction, respectively. However, the results of this study must be considered to be purely indicative since the method is operator dependent and scarcely reproducible. Also, our experience is that early catheter removal on days 5 to 7.
postoperatively decreases the risk of infection and the incidence of urge incontinence.

Briefly, postoperative continence is normally regained in up to 12 months. Many factors condition the quality of the postoperative result. Patient age and pathological disease stage significantly influence the recovery of continence. The formation of scars in the anastomosis area can also determine incontinence, especially after some time has passed. In general it can be presumed that continence recovery depends on the capacity of the rhabdosphincter for hypertrophy and for becoming more efficient after postoperative weakening. In all patients intense physiotherapy, Kegel exercises, biofeedback, etc are recommended to achieve continence recovery. Some patients regain continence before and better than others due to individual anatomical and functional characteristics. Hammerer and Huland proved that patients who are incontinent after RRP have decreased anatomical and functional length of the urethral sphincteric complex compared to continent patients, while the progressive recovery of continence is accompanied by a progressive increment in urethral functional length and closure pressure.\(^2\)

The purpose of the technique presented in this study is that of preserving the urethral sphincteric complex in the anatomical and functional position that most favors a rapid return to continence. Of the 24 group 1 patients who underwent nerve sparing surgery and had 18 months of followup 11 (46%) recovered sexual function. Similarly 8 of 19 patients (42%) in group 2 recovered sexual function. These limited data suggest that sphincter reconstruction does not make it more difficult to conserve the neurovascular bundles, which run lateral to the sphincter suspension sutures.

We noted that 18.6% of group 1 specimens had positive margins, in accordance with the percent reported by others,\(^22\) suggesting the attainment of an acceptable level of oncological radicalness. Our operation always involves bladder neck removal, which in our opinion seems important for limiting disease recurrence.

**CONCLUSIONS**

Our modifications to the Walsh RRP, which are not demanding from a technical point of view, have enabled us to achieve a major and significant decrease in time to continence compared to our historical series without compromising surgical radicalness. Early results with the new technique were so promising that we considered it unethical to continue with the standard technique to perform a randomized study. We found that, when indicated, nerve sparing could be performed as normal and our limited data on the recovery of sexual function suggest that nerve sparing is not compromised by the operation. Our approach makes a substantial contribution to decreasing patient discomfort in the first 3 months postoperatively.

**REFERENCES**


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**Abbreviations and Acronyms**

PSA = prostate specific antigen

RRP = radical retropubic prostatectomy

