Arch Gynecol Obstet (2011) 284:125–130
DOI 10.1007/s00404-010-1619-6

GENERAL GYNECOLOGY

Effects of lumbar lordosis and pelvic inlet orientation on the outcome of the transobturator tape sling operation in women

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Received: 25 May 2010 / Accepted: 19 July 2010 / Published online: 31 July 2010

Abstract
Purpose To determine the association between changes in lumbar lordosis (LL) and/or pelvic inlet (PI) orientation and the outcome of a transobturator tape (TOT) sling procedure.
Methods The study population consisted of 70 patients who underwent the TOT sling procedure for stress urinary incontinence, and were evaluated by a stress test at the sixth month after the surgery. The women were defined as continent on the absence of both subjective complaint of leakage and objective leakage as a result of the test. Cases that failed, even though improvement may have been observed, were considered incontinent. With the use of a standardized protocol, lateral lumbosacral spine/pelvic X-rays were taken with the participants standing in their usual upright posture with hands kept at chest level. From these X-rays, the angle of LL and PI were measured.
Results Of the 70 cases, 42 were continent and 28 were incontinent according to the evaluation done during the sixth month after the TOT procedure. There were no significant differences with respect to age, body mass index, gravidity, vaginal parity, pelvic organ prolapse and comorbid diseases between the continent and incontinent groups. The mean angle of PI in the continent group (34°, range 20–50) was significantly lower than in the incontinent group (37°, range 28–60) ($p = 0.012$). There was no significant difference in the median angle of LL (32°, range 15–50 in continent group, 34.5°, range 21–56 in incontinent group, $p = 0.13$) between the two groups.
Conclusions Women with continence after the TOT sling procedure have lower angle of PI than women with incontinence.

Keywords Anatomy · Female · Lordosis · Outcome · Pelvis · Transobturator tape

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Introduction

Stress urinary incontinence (SUI) and pelvic organ prolapse (POP) are common, often debilitating conditions, necessitating surgical correction in 11% of women by the age of 80 years [1]. A common pathophysiology may be implied as etiological and aggravating factors are similar and both arise from a failure of pelvic floor support [2]. The basic risk factors noted as contributing to these

conditions are obstetrical past, urogynecological history, atrophic changes in the urogenital area and diseases that are related to an increase in intra-abdominal pressure, such as obesity, chronic constipation and diseases associated with persistent cough.

SUI among women older than 40 years is common, ranging from 7 to 56% [3, 4]. Suburethral tapes, such as the transobturator tape (TOT) and the tension-free vaginal tape (TVT) are popular methods for the management of SUI. In a study of TOT effectiveness by Porena et al. [5] at a mean postoperative time of 32 months, 'dry' and 'improved' rates were 77 and 91%, respectively.

Identifying factors that can be associated with persistent SUI after surgery is of the utmost importance because postoperative incontinence undermines the success perceived by the patient and physician. Unfortunately, most of the factors that influence the outcome of mid-urethral sling procedures have not been identified. Surgeons have traditionally attributed recurrent SUI to technical failure resulting from surgeon inexperience, faulty surgical technique or incorrect diagnosis of genuine SUI [6]. Some anatomic alternations are considered among the risk factors for SUI and POP [7, 8]. However, the relation between SUI and the bony pelvis and spinal curvature in providing support to the pelvic viscera has not been examined extensively in women.

The purpose of the study is to determine the association between outcomes of the TOT sling procedure and changes in lumbar lordosis (LL) and/or pelvic inlet (PI) orientation.

Materials and methods

Following the approval of the local ethics committee, the clinical records of three different departments, from July 2009 to November 2009, were retrospectively reviewed to determine the women who underwent the TOT sling procedure for SUI and who had been evaluated by a stress test at 6 months after surgery. A total of 175 women meeting these conditions were asked to participate in our study. Three surgeons were involved in the study. Patients with mixed incontinence were also included in the study. None of the patients had a concomitant prolapse repair performed since women who had grade III or greater POP were excluded. The cough stress test was performed in the supine and standing positions at 300 ml bladder filling. Women enrolled to our study were classified into two groups according to their continence status at the sixth month after the TOT sling procedure: continent (group 1) and incontinent (group 2). The women were defined as continent on the absence of both subjective complaint of leakage and objective leakage observed in the stress test performed. All other cases (failure or improved—fewer symptoms than before operation, but not dry) were considered incontinent. De novo urge complaints were not included while the results of the study were analyzed. All patients underwent the TOT procedure (using polypropylene monofilament mesh). The TOT procedure was performed as described by Delorme: a skin incision was made in the genitofemoral fold at the level of the clitoris and the tape was inserted through the obturator foramen underneath the urethra, after which the vaginal wall was re-approximated with a running Vicryl 2/0 suture. A urethral catheter was left overnight in each case [9].

With the use of a standardized protocol, lateral lumbosacral spine/pelvic X-rays were taken while the participants were standing in their usual upright posture with their hands kept at chest level. All participants were barefoot during the X-rays. The X-rays were taken by technicians and the angle of LL and angle of the PI were measured (Fig. 1) by the first author (TS) who was blind to the continence status of the participants. The angle of LL was calculated from the intersection of lines drawn across the tops of the first and fifth lumbar vertebrae [10]. The angle of PI was the angle between the vertical axis and a line drawn from the sacral promontory to the top of the pubic bone [11].

A detailed clinical and demographic questionnaire is part of our normal preoperative protocol. The questionnaire specifically concentrates on the risk factors for the development of SUI: age, vaginal parity, smoking, obesity, menopause, chronic cough, previous urogenital surgery, radiation and neurologic diseases. Information regarding

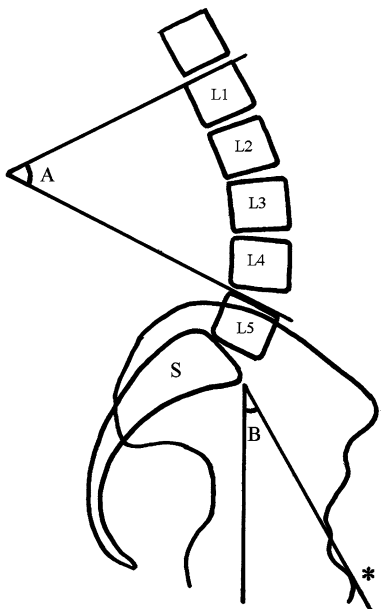

Fig. 1 Measurements of the angle of lumbar lordosis (**a**) and the angle of the pelvic inlet (**b**). *S* sacrum. Top (*asterisk*) of the pubic bone

comorbid diseases (e.g., asthma, diabetes, hypertension) was obtained from patient charts.

Exclusion criteria included the presence of a pelvic mass greater than 5 cm, previous pelvic irradiation or abdominal or pelvic surgery (including hysterectomy), chronic cough, history of pulmonary disease, connective tissue disease or conditions affecting the spinal cord or pelvic nerve roots or unwillingness to participate in the study. According to Shapiro–Wilk test result, all data were found to be non-normality distributed. The χ^2 test, Fisher's exact test and the Mann–Whitney U test were used for statistical analysis. Statistical significance was defined using a $p < 0.05$. All analyses were performed using SPSS 15.0 (SPSS Inc, Chicago, IL, USA) statistical package.

Results

A total of 70 women were enrolled in the study. A total of 105 patients did not enroll to the study because of the exclusion criteria ($n = 28$) and unwillingness to take part ($n = 77$). Of the 70 cases, 42 were continent and 28 were incontinent according to the evaluation performed at the sixth month after the TOT procedure. The incontinent (failure or improved: fewer symptoms than before operation but not dry) rates were equal among the three surgeons (38.8, 40 and 41.6%). Although 7 patients had unchanged symptoms, 21 had improved symptoms in the incontinent group. The characteristic data of the participants are presented in Table 1. All participants were vaginally parous. No difference in the baseline characteristics, except height, was observed between the two groups (Table 1). The number of postmenopausal women were 18 and 16 in groups 1 and 2, respectively, and none of them received hormone replacement therapy ($p = 0.46$). The number of women with POP were 23.8 and 7.1% in groups 1 and 2, respectively ($p = 0.1$) and none was greater than grade 2. The measurements of the angles of LL and PI of the women in the two groups are shown in Table 2. The median (range) angle of PI was 34° (20°–50°) and 37° (28°–60°) in groups 1 and 2, respectively ($p = 0.012$). There was no significant difference in the median angle of LL [32° (range 15°–50°) compared with 34.5° (range 21°–56°), $p = 0.13$] of groups 1 and 2, respectively. A relative loss of LL was demonstrated in the continent group.

Table 1 Demographic and clinical characteristics of groups

	Group 1 (continent)	Group 2 (incontinent)	p value
No. of pts	42	28	
Age (years)			
Median (range)	47 (40–63)	52 (40–66)	0.093
Mean pt ± SD	49.3 ± 6.3	52.5 ± 8.2	
Height (cm)			
Median (range)	159 (145–172)	161.5 (152–171)	0.03
Mean ± SD	159.1 ± 6.4	162.1 ± 5.6	0.03
Weight (kg)			
Median (range)	74 (60–99)	80 (64–110)	0.054
Mean ± SD	74.7 ± 11.7	80.7 ± 12.8	
Body mass index (kg/m^2)			
Median (range)	28.3 (23.7–45.2)	30.25 (23.3–41.4)	0.388
Mean ± SD	29.5 ± 5.04	30.5 ± 5.43	
No. of gravidity			
Median (range)	4 (1–9)	2.5 (1–6)	0.069
Mean ± SD	3.5 ± 1.8	2.8 ± 1.5	
No. of vaginal parity			
Median (range)	3 (1–9)	2.5 (1–6)	0.118
Mean ± SD	3.3 ± 1.9	2.7 ± 1.7	
No. of comorbid diseases (%)	20 (52.6)	18 (47.4)	0.17
No. of prolapsus (%)	10 (23.8)	2 (7.14)	0.106
No. of menopause (%)	18 (42.8)	16 (57.1)	0.46

Table 2 Angle of the lumbar lordosis and pelvic inlet in women who became continent and remained incontinent after the transobturator tape sling procedure

	Group 1 (continent)	Group 2 (incontinent)	p value
Angle of LL (°)			
Median	32 (15–50)	34.5 (21–56)	0.13
Mean ± SD	32.3 ± 9.6	37.1 ± 11.3	
Angle PI (°)			
Median	34 (20–50)	37 (28–60)	0.012
Mean ± SD	33.3 ± 8.7	39.3 ± 8.6	
Ratio of angle of LL/PI			
Median (range)	1 (0.405–2)	0.922 (0.411–1.533)	0.487
Mean ± SD	1.05 ± 0.45	0.97 ± 0.29	

LL lumbar lordosis, *PI* pelvic inlet

Discussion

Despite its prevalence and significant impact on the health-care system, the pathophysiology of SUI, and of similarly recurrent SUI after anti-incontinence procedures, remains poorly understood. When trying to identify risk factors for recurrent SUI, many investigators have focused on surgical techniques [6].

Minimally invasive mid-urethral slings are now the first-line surgical treatment for female SUI, and TOT and TVT are the most popular methods. However, 5–20% of treated patients experience surgical failure with recurrent or persistent SUI [12–14]. Two meta-analyses have demonstrated

that TVT and TOT had similar efficacy, although the risk of bladder perforations, pelvic hematoma and lower urinary tract symptoms was significantly less common in patients treated with TOT [15, 16]. In a recent study, Novara et al. reported that classic TVT was shown to be followed by significantly higher objective continence rates than TOT, but the data were not reconfirmed in sensitivity analyses limited to high-quality trials; however, no difference was noted in subjective continence rates [17]. Fisher et al. [18] reported that the failure and improved (fewer symptoms than before the operation but >2 g/h) rate was 9 and 10% using TOT, respectively. In another study by Porena et al. at a mean of 32 months, the failure and improved (fewer symptoms than before the operation) rates after TOT were reported as 9 and 14%, respectively [5].

The reason for failure of the primary mid-urethral sling is unclear but may be related to improper adjustment of the sling at placement or misplacement of the suburethral tape. However, not all causes of recurrent SUI are related to surgical techniques or the type of the material used. It is plausible that some anatomical factors that would increase intra-abdominal and intravesical pressure can make women more vulnerable to recurrent SUI. Guerette et al. [19] found that the cutoff values of maximal urethral closure pressure (MUCP) >40 cm H_2O and Valsalva leak point pressure >60 cm H_2O were the most predictive of surgical success for the TOT procedure. Miller et al. [20] also reported that the TOT was nearly six times more likely to fail than the TVT at 3 months after surgery in patients with a MUCP of ≤42 cm H_2O. The most plausible explanation for these findings is that the TOT tape had a more oblique and lateral direction to reproduce the pelvic hammock support than the TVT tape [21, 22]. This may result in a lower circumferential compressive effect on the urethra, a smaller increase in urethral pressure [23] and, theoretically, an increased the risk of failure after the TOT procedure compared with the TVT procedure [24] in patients with much more intra-abdominal pressure. These findings indicate that a degree of intra-abdominal pressure has a role in the outcome of sling procedures. Anatomical factors, such as bones and/or muscles may play role in this situation.

It has been proposed that the forward lumbar curve of the human spine and the orientation of the pelvis help support the abdominal viscera and deflect and/or absorb a fraction of the downward intra-abdominal forces before they reach the pelvic floor. To our knowledge, the association between spinal curvature abnormalities, bony pelvic variations and SUI has not been not extensively studied. Stav et al. [8] specifically evaluated different bone parameters, pelvic floor muscle angles, densities and cross-sectional areas using multiplanar reformation and three-dimensional techniques (volume rendering) in women with SUI. They reported that the PI and pelvic outlet diameters are major risk factors for development of urinary incontinence in women. According to these authors, greater inlet and outlet diameters (either congenital or biomechanical) in incontinent females clearly imply a larger pelvic floor area compared with continent females. The authors also reported that this structural difference will result, with age, in a more dramatic elongation and weakening of the pelvic floor muscles, fascias and ligaments among incontinent females, the outcome of which will be a loose, deeply concave-shaped pelvic floor, incapable of rendering support to the pelvic structures.

The orientation of the PI is also thought to be a protective mechanism against POP [7]. The PI is oriented in an almost vertical position such that most of the downward intra-abdominal force is directed towards the pubic bone and rectus abdominis muscles before they reach the pelvic floor. Nguyen et al. [7] found that women with advanced POP had a significantly higher PI angle than women without prolapse (37.5° compared with 29.5°); that is, the PI was oriented more vertically in women with normal pelvic organ support than in women with prolapse. This difference in PI orientation may result, theoretically, in a higher proportion of intra-abdominal forces exerted on the pelvic floor and may predispose women to POP. Whether risk factors for persistent SUI after mid-urethral sling procedures are the same as those for the initial development of SUI and/or POP is not known.

To date, the effect of patient characteristics of spinal curvature and bony pelvis on the outcome of mid-urethral sling procedures has not been systemically addressed. We tried to determine, for the first time, the angle of LL and PI as potential risk factors of persistent SUI after the TOT procedure. We found that women who became continent after the TOT procedure had a significantly lower angle of PI than women who remained incontinent. The lower angle of PI may help in preventing persistent SUI after the TOT procedure by deflecting and/or absorbing a fraction of the downward intra-abdominal forces before they reach the pelvic floor. This affirmation is in accordance with our results. In addition, the lower angle of PI may lead to a smaller pelvic floor area in a similar way to smaller inlet and outlet diameters. Based on the effects of the angle of PI mentioned above, a greater angle of PI may be a reason for persistent SUI after the TOT sling procedure. In the present study, we calculated a cut-off value for PI angle as 43.5° to predict the TOT procedure outcome. Although only 2 (5%) patients had a greater than 43.5° PI angle in group 1, 8 (29%) patients exceeded this angle in group 2.

On the other hand, there was no significant difference in the mean angle of LL between the two groups in our study. Our results show that angle of PI is more important than angle of LL on deflecting the downward intra-abdominal forces towards the pubic bone and rectus abdominis muscles before they reach the pelvic floor. Both a decrease in

angle of LL and an increase in angle of PI, in women, may result, theoretically, in a higher proportion of intra-abdominal forces exerted on the pelvic floor and therefore a higher risk of TOT failure. For this reason, a ratio of the angles of LL and PI was evaluated as a measure of the outcome of the TOT procedure. Although a relatively lower ratio of LL/PI was demonstrated in the incontinent group, there was no significant difference between the two groups ($p = 0.487$). This may be due to a small sample size. The loss of LL within the continent group might be related with a decrease in the PI angle anthropologically, and PI angle may be more important in continence physiopathology. Further studies should be conducted with higher patient numbers to show the exact role of LL angle in continence physiopathology. Although the incontinent patients were on average taller in our study, the numerical difference between both groups was small (median 159 vs. 161.5 cm). Therefore, this situation might not have clinical importance in this study.

On the other hand, if there is an association between the outcome of the TOT sling procedure and anatomic variations of patients, not only bones but muscles may have a role. In contrast to general thinking, Smith et al. [25] reported that women with more severe incontinence had a trend for greater pelvic floor and greater obliquus externus abdominis electromyographic activity than continent women or women with mild incontinence. Thus, in women with more severe incontinence, pelvic floor muscle activity may be insufficient to maintain continence in the presence of increased obliquus externus abdominis muscle activity and intra-abdominal pressure. Our findings show that PI angle may be another factor that leads to inadequate control of continence, theoretically by causing a larger pelvic floor area and a higher proportion of intra-abdominal forces to exert on the pelvic floor.

Interestingly, there is a difference between success rates of TOT and TVT when these methods were performed as repeat procedures after failed cases. Stav et al. [26] reported that while the lowest subjective cure achieved was 40% in a repeat obturator sling after failed obturator sling cases, the highest subjective cure rate achieved was 74% in a repeat retropubic sling after failed obturator sling cases. Lee et al. [27] reported similar trends, with a repeat retropubic mid-urethral sling having a higher success rate than a repeat transobturator mid-urethral sling (92.3 vs. 62.5%). The reason for this may be related to differences of the routes in the transobturator and retropubic approaches. It would be important to investigate the effect of anatomical variation of patients on the cure rate of repeat mid-urethral slings. The angles of LL and PI, whether or not significantly affecting the successful outcome of repeat TVT procedures, need to be investigated to explain the role of anatomy in these cases.

We believe that we have presented valuable information on a relatively unexplored subject. Some limitations should be pointed out with regard to the study design. Although these skeletal changes result, theoretically, in a variable amount of intra-abdominal force exerted on the pelvic floor, we did not measure or compare the intra-abdominal pressures of the participants. Our study was also based on a very specific patient population with regard to prior pelvic surgery, prolapse and it includes only Turkish women. The population size was small since most of the recovered continent patients were unwilling to participate in this study and the follow-up period was relatively short. On the other hand, the potential failures of incontinence surgery may be associated with lower leak point pressures, which was not evaluated as a factor in our study as urodynamic analyses were not performed. This relationship may be the subject of future studies. The surgeries were performed by three different surgeons; however, we believe that this was not relevant to differences between cases since the TOT procedure is well standardized.

Conclusion

Our findings suggest that high angle of PI may be associated with persistent incontinence after the TOT sling procedure in patients with SUI. Further studies regarding the role of the LL angle and PI angle in the etiology of SUI and outcome of the repeat sling procedure are needed in order to support our conclusions.

Conflict of interest We declare that we have no conflict of interest.

References

1. Olsen AL, Smith VJ, Bergstrom JO, Colling JC, Clark AZ (1997) Epidemiology of surgically managed pelvic organ prolapse and urinary incontinence. Obstet Gynecol 89:501–506
2. Hilton P, Dolan LM (2004) Pathophysiology of urinary incontinence and pelvic organ prolapse. BJOG 111(Suppl 1):5–9
3. Mayne CJ, Assassa RP (2004) Epidemiology of incontinence and prolapse. BJOG 111:2–4
4. Hunskaar S, Arnold EP, Burgio K, Diokno AC, Herzog AR, Mallett VT (2000) Epidemiology and natural history of urinary incontinence. Int Urogynecol J Pelvic Floor Dysfunct 11:301–319
5. Porena M, Costantini E, Frea B, Giannantoni A, Ranzoni S, Mearini L et al (2007) Tension-free vaginal tape versus transobturator tape as surgery for stress urinary incontinence: results of a multicentre randomised trial. Eur Urol 52:1481–1490
6. Amaye-Obu FA, Drutz HP (1999) Surgical management of recurrent stress urinary incontinence: a 12-year experience. Am J Obstet Gynecol 181:1296–1307
7. Nguyen JK, Lind LR, Choe JY, McKindsey F, Sinow R, Bhatia NN (2000) Lumbosacral spine and pelvic inlet changes associated with pelvic organ prolapse. Obstet Gynecol 95(3):332–336

8. Stav K, Alcalay M, Peleg S, Lindner A, Gayer G, Hershkovitz I (2007) Pelvis architecture and urinary incontinence in women. Eur Urol 52:239–244
9. Delorme E (2001) Transobturator urethral suspension: miniinvasive procedure in the treatment of stress urinary incontinence in women. Prog Urol 11:1306–1313
10. Wiltse LL, Winter RB (1983) Terminology and measurement of spondylolithesis. J Bone Joint Surg 65-A:768–772
11. Smith ARB, Hosker GL, Warrell DW (1989) The role of partial denervation of the pelvic floor in the aetiology of genitourinary prolapse and stress incontinence of urine: a neurophysiological study. Br J Obstet Gynaecol 96:24–28
12. Merlin T, Arnold E, Petros P et al (2001) A systematic review of tension-free urethropexy for stress urinary incontinence: intravaginal slingplasty and the tension-free vaginal tape procedures. BJU Int 88:871
13. Lo TS (2004) Tension-free vaginal tape procedures in women with stress urinary incontinence with and without co-existing genital prolapse. Curr Opin Obstet Gynecol 16:399
14. Nilsson CG, Falconer C, Rezapour M (2004) Seven year follow-up of the tension-free vaginal tape procedure for treatment of urinary incontinence. Obstet Gynecol 104:1259
15. Novara G, Ficarra V, Boscolo-Berto R, Secco S, Cavalleri S, Artibani W (2007) Tension-free midurethral slings in the treatment of female stress urinary incontinence: a systematic review and meta-analysis of randomized controlled trials of effectiveness. Eur Urol 52:663–679
16. Novara G, Galfano A, Boscolo-Berto R et al (2008) Complication rates of tension-free midurethral slings in the treatment of female stress urinary incontinence: a systematic review and meta-analysis of randomized controlled trials comparing tension-free midurethral tapes to other surgical procedures and different devices. Eur Urol 53:288–309
17. Novara G et al (2010) Updated systematic review and meta-analysis of the comparative data on colposuspensions, pubovaginal slings, and midurethral tapes in the surgical treatment of female stress urinary incontinence. Eur Urol. doi:10.1016/j.eururo.2010.04.022)
18. Fischer A, Fink T, Zachmann S, Eickenbusch U (2005) Comparison of retropubic and outside-in transoburator sling systems for the cure of female genuine stress urinary incontinence. Eur Urol 48:799–804
19. Guerette NL, Bena JF, Davila GW (2008) Transobturator slings for stress incontinence: using urodynamic parameters to predict outcomes. Int Urogynecol J 19:97–102
20. Miller JJ, Botros SM, Akl MN et al (2006) Is transobturator tape as effective as tension-free vaginal tape in patients with borderline maximum urethral closure pressure? Am J Obstet Gynecol 95:1799–1804
21. Hsiao SM, Chang TC, Chen CH et al (2008) Sequential comparisons of postoperative urodynamic changes between retropubic and transobturator tape procedures. World J Urol 26:643–648
22. DeLancey JO (1994) Structural support of the urethra as it relates to stress urinary incontinence: the hammock hypothesis. Am J Obstet Gynecol 170:1713–1720
23. Hsiao SM, Sheu BC, Lin HH (2008) Sequential assessment of urodynamic findings before and after transobturator tape procedure for female urodynamic stress incontinence. Int Urogynecol J 19:627–632
24. Hsiao SM, Chang TC, Lin HH (2009) Risk factors affecting cure after mid-urethral tape procedure for female urodynamic stress incontinence: comparison of retropubic and transobturator routes. Urology 73(5):981–986
25. Smith MD, Coppieters MW, Hodges PW (2007) Postural response of the pelvic floor and abdominal muscles in women with and without incontinence. Neurourol Urodyn 26:377–385
26. Stav K, Dwyer PL, Rosamilia A, Schierlitz L, Lim YN, Chao F et al (2010) Repeat synthetic mid urethral sling procedure for women with recurrent stress urinary incontinence. J Urol 183:241–246
27. Lee KS, Doo CK, Han DH et al (2007) Outcomes following repeat mid urethral synthetic sling after failure of the initial sling procedure: rediscovery of the tension-free vaginal tape procedure. J Urol 178:1370