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ORIGINAL ARTICLE

# Treatment of stress urinary incontinence in men with spinal cord injury: minimally invasive = minimally effective?

J Pannek and J Wöllner

**Study design:** Retrospective chart review.
**Objectives:** To assess the outcome of minimally invasive treatment of stress urinary incontinence with alloplastic slings in patients with neurogenic lower urinary tract dysfunction.
**Setting:** Switzerland.
**Methods:** The patient database of a tertiary urologic referral center was screened for male patients with SCI who underwent implantation of a suburethral sling between June 2009 and December 2015. Patient characteristics and bladder management details were collected by chart review.
**Results:** Sixteen patients were identified. Of those, 13 received a transobturator tape (TOT) and three underwent implantation of an retropubic adjustable system (RAS). In the TOT group, nine patients became continent, one patient was improved and three patients remained unchanged. Three patients underwent minor revisions due to impaired wound healing. In the RAS group, no patient improved and one RAS had to be removed due to severe wound infection; in a second patient, an abscess with destruction of the urethra occurred.
**Conclusions:** In our experience, alloplastic slings seem to be an effective minimally invasive treatment option in male patients with SUI due to SCI. TOT seem to be more effective than RAS and was associated with less severe complications. The selection criteria for the optimal patient and the optimal sling have to be further defined.
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## INTRODUCTION

Virtually all persons with spinal cord injury (SCI) suffer from neurogenic lower urinary tract dysfunction (NLUTD). Although an elevated storage pressure, either due to low bladder compliance or due to detrusor overactivity, is the major risk factor for renal deterioration,[1] urinary incontinence has the most detrimental influence on the quality of life.[2] Suprasacral lesions frequently lead to detrusor overactivity, causing reflex incontinence. In a significant proportion of these patients, continence can be achieved by suppression of detrusor overactivity. Infrasacral lesions, however, are commonly associated with sphincter deficiency, leading to stress urinary incontinence (SUI). For the treatment of SUI in patients with NLUTD, implantation of an artificial urinary sphincter is regarded as gold standard today, leading to continence in >80% of the patients.[3] However, long-term follow-up demonstrates significant complication rates, requiring surgical revision in a substantial percentage of the patients.[4] Therefore, some of the new, minimally invasive techniques that are utilized for the treatment of non-neurogenic SUI have been assessed in patients with NLUTD as well, but experience with these devices is limited. Concerning suburethral alloplastic slings, the most frequently used minimally invasive procedure in post-prostatectomy incontinence, merely two studies with small sample sizes exist in men with NLUTD.[5,6] To add to the existing, very limited knowledge, we present the single-center experience with male suburethral slings in patients with NLUTD.

## MATERIALS AND METHODS

### Patient selection

By a systematic chart review of all patient charts beginning in 2009 (first implantation of a male sling at our hospital), we identified all male patients with SCI who received an alloplastic suburethral sling due to neurogenic SUI at our institution. The retrospective data collection was approved by the local ethics committee.

### Methods

Patients with urodynamically proven SUI due to insufficiency of the bladder neck and/or the external sphincter, either due to NLUTD or due to previous sphincterotomy without significant neurogenic detrusor overactivity (NDO) were counseled concerning the different treatment options. In patients opting for an alloplastic sling, we initially used a re-adjustable alloplastic sling (RAS) (Remeex, Neomedic international, Calatayud, Spain), but changed to a non-adjustable transobturatoric alloplastic sling (TOT) (I-Stop Toms, CL Medical, Sainte-Foy-Lès-Lyon, France) after three patients. Prior to surgery, all patients underwent video-urodynamic examination, renal ultrasound and cystoscopy.

All patients presented at our department for follow-up examinations, including video-urodynamics, renal ultrasound and clinical examination three months after the implantation and then every 12 months. Subjective continence was assessed by a standardized semi-structured interview. All further complications and surgical procedures were documented.

Cure was stated if no pads or continence aids were used. Improvement was stated if the number of pads were reduced by at least 50% or if pads could be used instead of a condom urinal.

Neuro-Urology, Swiss Paraplegic Centre, Nottwil, Switzerland
Correspondence: Professor J Pannek, Neuro-Urology, Schweizer Paraplegiker-Zentrum, Guido A. Zäch Strasse 1, Nottwil CH – 6207, Switzerland.
E-mail: juergen.pannek@paraplegie.ch
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**Table 1 The demographic data**

| | *Mean* | *Range* | *Median* |
|---|---|---|---|
| Age (years) | 53.5±16.4 | 28–81 | 53.3 |
| Time since injury (years) | 19.2±14.1 | 1–41 | 20.1 |
| *Level of lesion* | *Complete* | *Incomplete* | *Total* |
| Cervical | 2 | 2 | 4 |
| Thoracic | 7 | 1 | 8 |
| Lumbar | 4 | 0 | 4 |

Abbreviation: AIS, ASIA impairment Score.
Complete: AIS (ASIA impairment Score) A.
Incomplete: AIS B-D.

**Table 2 Bladder management and use of protective devices**

| *Group* | *No. before surgery (%)* | *No. after surgery (%)* |
|---|---|---|
| IC | 9 (56.25) | 8 (50.0) |
| TUC | 2 (12.5) | 0 |
| SPC | 2 (12.5) | 5 (31.25) |
| Reflex voiding | 3 (18.75) | 3 (18.75) |
| Pads (mean) | 3.1 | 1.62 |
| Condom urinal | 3 | 1 |

Abbreviations: IC, intermittent catheterization; SPC, suprapubic catheter; TUC, transurethral indwelling catheter.

The study has been approved by the local ethics committee.

### Statistical analyses

Statistical analyses were performed with SPSS statistical software (SPSS; Irvine, CA, USA). All values were given as means and standard deviation (s.d.). A *P*-value of $<0.05$ was considered significant.

## RESULTS

We identified 16 men who underwent sling implantation between July 2009 and December, 2015. The mean age of the patients was 53.5 years. The majority of patients ($n=9$) emptied their bladders by intermittent catheterization (IC), whereas three patients performed reflex voiding and four men used an indwelling (transurethral: $n=2$; suprapubic (SPC): $n=2$) catheter. In the four patients with cervical lesions, incontinence was due to previous sphincterotomy.

After surgery, the two patients with transurethral catheters were using an SPC, and one patient changed from IC to SPC due to destruction of the urethra caused by the sling (Tables 1 and 2).

None of the three patients with the RAS improved regarding his continence status. However, we observed two major complications (infection of the implant requiring removal and perineal abscess formation with erosion of the urethra). In the former case, the patient remained incontinent, whereas the latter patient was treated with SPC insertion and closing of the urethra due to his age and general health.

On the basis of these experiences, in all other patients, a TOT was used. Nine of the 13 patients became continent, one man improved significantly, and in three patients, the incontinence was unchanged. Two of the three patients using a condom urinal could change to pad use due to improvement of the incontinence. The mean pad use decreased from 3.1 pads per day to 1.6 pads. In the TOT group, three patients developed superficial secondary wound healing, which was treated by revision and surgical closure of the wound. No tape had to be removed. No other complications were noted (Table 3).

**Table 3 Success rate and complications**

| | *TOT (%)* | *RAS (%)* | *Total (%)* |
|---|---|---|---|
| Continent | 9 (69.2) | 0 (0) | 9 (56.25) |
| Improved | 1 (7.7) | 0 (0) | 1 (6.25) |
| Unchanged/worse | 3 (23.1) | 3 (100) | 6 (37.5) |
| Complications requiring surgical intervention | 3 | 2 | 5 |

Abbreviations: RAS, retropubic adjustable system; TOT, transobturator tape.

**Table 4 Urodynamic results**

| | *Before surgery* | *After surgery* |
|---|---|---|
| Capacity (ml) | 421.6±143.5 | 344.1±168.0 |
| Compliance (ml $cm^{-1}$ $H_2O$) | 88.0±107.6 | 64.1±68.6 |
| Maximum detrusor pressure (cm $H_2O$) | 22.3±15.5 | 15.6±10.4 |

In 10 patients (all TOT implantation), the urodynamic data were available before and after sling insertion. Prior to surgery, mean bladder capacity (421 ml) and compliance (mean 81 ml $cm^{-1}$ H2O) were in normal ranges. Detrusor overactivity was either absent due to the level of lesion or sufficiently suppressed (maximum detrusor pressure (pdetmax): 22.3 cm H2O) either by antimuscarinic drugs ($n=2$), onabotulinum toxin injections ($n=1$) or bladder augmentation ($n=1$).

After sling insertion, all patients continued their bladder medication. The mean urodynamic data remained basically unaltered (capacity 344 ml, compliance 64.1 ml $cm^{-1}$ H2O, pdetmax 15.6 cm H2O). In the patients with reflex voiding, maximum detrusor pressure at reflex voiding remained unchanged after surgery (Table 4).

In none of the patients, sonographic signs for renal damage, for example, dilatation, was detected.

The clinical data of each individual patient, including urodynamic results, are summarized in Table 5.

## DISCUSSION

Our study demonstrated that alloplastic slings are an effective therapeutic option in patients with SUI due to SCI. In our experience, TOT are associated with less problems than the RAS we used, which we abandoned because of significant complications.

SUI remains to be a therapeutic challenge in men with NLUTD due to SCI. Especially SCI below the level of the sacral micturition center commonly leads to neurogenic SUI due to sphincteric insufficiency. As physiotherapy is not feasible in the majority of patients due to the underlying pathology, and no licensed, effective drug treatment is available, SUI is frequently treated surgically. For this indication, several procedures have been utilized, including bladder neck closure, urethral lengthening procedures, artificial urinary sphincter (AUS), urethral bulking agents, bladder wrap procedures and urethral slings.[4]

A recent meta-analysis, evaluating all surgical treatment options for neurogenic SUI, including both genders, came to the conclusion that, in general, complication rates are higher and success rates are lower in neurogenic patients compared to non-neurogenic patients.[4] According to this analysis, AUS had the highest percentage of success, followed by urethral sling procedures, compared to the urethral bulking agents, which reported the highest rate of failure.

Until today, experience with alloplastic slings in male patients with SCI is scarce. To our knowledge, merely two studies exist in adult patients. One study evaluated the use of four different types of slings in 20 men. Their overall success rate was 29%, and seven patients

**Table 5 individual results**

| *Age* | *SCI level, AIS Score* | *Bladder management pre TOT* | *Surgery* | *Capacity pre* | *Pdetmax pre* | *Management (number of pads)* | *Capacity post* | *Pdetmax post* | *Bladder management post TOT* | *Status post* | *Incontinence management (number of pads)* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 81 | L3, A | Straining | TOT | 500 | 25 | Condom | NA | NA | Straining | Improved | 2 |
| 61 | Th11, A | ISC | TOT | 500 | 8 | 5 | NA | NA | ISC | Unchanged | 3 |
| 62 | C5, A | TUC | TOT | 90 | 42 | 3 | 160 | 20 | SPC | Continent | 1 |
| 46 | Th12, A | ISC | TOT | 425 | 14 | 3 | 500 | 16 | ISC | Continent | 1 |
| 36 | Th11, A | ISC | RAS | 466 | 4 | 3 | NA | NA | ISC | Unchanged | 2 |
| 73 | L2, A | ISC | TOT | 500 | 21 | 2 | 500 | 21 | ISC | Continent | 0 |
| 55 | Th5, B | TUC | TOT | 500 | 12 | 2 | 150 | 17 | SPC | Continent | 0 |
| 49 | C5, A | SPC | TOT | 350 | 39 | 4 | 290 | 7 | SPC | Continent | 0 |
| 61 | Th11, A | ISC | RAS | 500 | 8 | 4 | 500 | 2 | ISC | Continent | 1 |
| 30 | Th12, A | ISC | TOT | 500 | 13 | 4 | 630 | 12 | ISC | Continent | 0 |
| 56 | L1, A | ISC | TOT | 700 | 32 | 3 | 350 | 3 | ISC | Unchanged | 4 |
| 28 | L1, A | ISC | TOT | 495 | 6 | 2 | 250 | 21 | SPC | Continent | 0 |
| 30 | C4, C | SPC | TOT | 365 | 16 | 4 | 320 | 15 | SPC | Continent | 0 |
| 56 | Th6, A | Reflex voiding, | TOT | 275 | 57 | 4 | NA | NA | Reflex voiding | Improved | 4 |
| 77 | Th5, A | Reflex voiding | TOT | 210 | 23 | Condom | NA | NA | Reflex voiding | Unchanged | Condom |
| 55 | C6, C | ISC | RAS | 370 | 40 | 0 | 135 | 18 | ISC | Unchanged | 4 |

Abbreviations: AIS, ASIA impairment score; ISC, intermittent self-catheterization, NA, not applicable; Pdetmax, maximum detrusor pressure during the storage phase; RAS, retropubic adjustable system; SPC, suprapubic catheter; TOT, transobturator tape; TUC, transurethral catheter.

presented with either new onset low-compliance bladder ($n=5$) or detrusor overactivity ($n=2$). In addition, 30% of the patients underwent sling removal due to either infection or wound breakdown.[5] In a second study, an alloplastic sling was used in 20 males, with vastly better results. Positive effects were demonstrated in 13 of 20 patients (65%) at 1-year follow-up, with eight patients cured, five improved and seven failures. No severe complications were encountered, but temporary problems with self-catheterization were described.[6] The results of the latter study are comparable to our data and depict that male slings seem to be a feasible treatment option with adequate success rates and acceptable complication rates.

A potential risk of any SUI treatment in patients with NLUTD is the new onset of detrusor overactivity. This complication occurs frequently, in about 30% of the patients, after AUS insertion, and the onset may be delayed by several years.[7] Although the upper urinary tract and the urodynamic data remained unaltered in our and in Groens study, significant worsening of bladder dysfunction was described in about a third of the patients by Vainrib *et al.*, stressing the need of lifelong surveillance with urodynamic controls after surgical SUI treatment,[8] even after minimally invasive surgery.

Although a firm conclusion is hampered by the paucity of the data and the variety of sling systems used, the type of sling may have an influence on the results. As patients with SCI suffer from immune dysfunction,[9] they may be more prone to wound infection. The re-adjustable system we used initially requires sling readjustment by a screwdriver-like tool that is left in place for at least 1 day after surgery and may have contributed to the infections we encountered. In addition, other authors reported that due to the insufficient sphincter, they tended to apply some tension on the tape, which they did not do in non-neurogenic patients.[5] This fact could have played a role in the urethral or perineal complications we found in our patients with re-adjustable slings.

Our study has several limitations, especially the small number of patients and the retrospective nature of our evaluation. In addition, pad size was not standardized, and the change of the pads depended on the patients' preference, not on objective criteria (for example, pad weight). Currently, however, no study with more participants exist, as the number of patients suffering from SUI due to SCI is limited. Despite this fact, there is a high demand by this relatively small patient group for sufficient treatment, as SUI severely decreases QoL in the affected persons. Therefore, the experience even with a limited number of patients is helpful for choosing the best treatment option for the individual patient, as results from surgery in non-neurogenic patients are not comparable to those in neurogenic men.

For example, the AUS is the most frequently used option for SUI. Compared to patients with post-prostatectomy incontinence, success rates are lower and complication rates are higher in neurogenic patients.[10] Several factors may contribute to these findings, for example, the type of SUI (intrinsic sphincteric deficiency), the immune dysfunction, the changes in tissue vascularization in the affected area and the fact that the majority of patients with SCI is wheelchair-bound, leading to a long-lasting compression of the perineum. Second, due to the risk of erosion and cuff lesion by intermittent catheterization, the cuff is frequently placed at the bladder neck, which requires more extensive surgery. Despite modifications reducing the complication rate, long-term revision rate remains to be substantial.[11]

Comparison of the results for alloplastic slings show identical findings. In patients treated for post-prostatectomy incontinence with the same type of sling we used, the success rate was 87.5% (cured or greatly improved),[12] whereas this rate was 62.5% in our patient group. Groen described an improvement rate of 65% with another type of sling in patients with NLUTD,[6] whereas improvement rates were about 80% with the same type of sling in patients with non-neurogenic bladder dysfunction.[13]

Another possible drawback is the fact that we did not affect Valsalva leak point pressure before and after surgery. In our experience, this parameter is of limited value for the assessment of effectiveness of SUI treatment in men, and has been demonstrated not to be a prognostic factor for the outcome of SUI surgery in this group of patients.[14] Therefore, we relied on the analysis of urine loss during video-urodynamic examination and on patient history.

Certainly, other surgical treatments for SUI in male patients with SCI exist, but evidence for these procedures is either weak, as for periurethral balloons,[15] or success rates are low and transient, as for example, bulking agents.[4] Bulbourethral slings have been proven to be a moderately effective treatment option in men[14] not surpassing our

results with alloplastic slings, but they are more invasive than the latter. Therefore, these slings are a promising, minimally invasive treatment option in men with SCI. However, long-term results are not available. Furthermore, currently, as in non-neurogenic SUI, patients with moderate incontinence have been selected for sling procedures, but this selection was rather done intuitively, as no evidence-based selection criteria exist. In addition, in our group, success rates and complications varied widely between the two different slings used. Prospective studies are necessary to evaluate the long-term efficacy and complication rates, and to define selection criteria for appropriate patients as well as for the appropriate slings for this procedure.

## CONCLUSION

Alloplastic transobturator slings seem to be a promising, minimally invasive surgical treatment option for male patients with SCI and SUI with acceptable success rates and tolerable complication rates. Prospective long-term studies are required to better define the appropriate patients for these procedures and to evaluate long-term success rates.

## DATA ARCHIVING

There were no data to deposit.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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