Urethro-plasty, a Novel Operation based on a New Concept

October 10, 2010 | Urogynecology [1], Incontinence [2]
By OBGYN.net Staff [3]

Urethro-plasty, a Novel Operation based on a New Concept, for the Treatment of Stress Urinary Incontinence (SUI) Detrusor Instability (DI), and Mixed-type of Urinary Incontinence

Synopsis: Urethro-plasty is mending the torn wall of the internal urethral sphincter and closing the rupture that causes SUI, DI and mixed urinary incontinence; and fortifying the sphincter, further, by fixing longitudinally a rectangular piece of vagina on the mended wall. The sphincter, thus regains its integrity and strength to resist sudden increases of pressure.

Keywords: Urethro-plasty, internal urethral sphincter, Urinary continence.

Abstract: Urethro-plasty, a Novel Operation based on a New Concept, for the Treatment of Stress Urinary Incontinence, SUI, Detrusor Instability, D.I., and Mixed-type of Urinary Incontinence.

Introduction: Urethro-plasty, a vaginal operation for surgical management of SUI, DI and Mixed-type of urinary incontinence is innovated, depending on, a new concept. SUI is a sequel of a weak, defective internal urethral sphincter, the defect is mostly due to traumatic rupture of its wall. The internal sphincter is a collagenous tissue cylinder that extends from the bladder neck down to the perineal membrane. Urethro-plasty, depends on identifying the defect, (rupture), in the wall of the sphincter, and mending the torn wall by simple interrupted sutures, urethro-raphy; and fortifying the sphincter further by fixing longitudinally a rectangular piece of vagina on the mended wall. In addition, it is an autologous source of collagen, and it separates the fortified repaired sphincter from the overlying repaired vagina. Thus the sphincter restores its integrity, and strength to resist sudden increases of pressure.

Aim of the study: Evaluating the results of this new operation, is done by assessing the patients soon after surgery and for up to 12months following surgery.

Study design: Urethro-plasty operation is done to cases with SUI, DI, and Mixed-type of urinary incontinence. The cases are followed up for continence up to 12months after the operation.

Results: Urethro-plasty had been done for 84 patients; success rate was 92.8%; 78 patients gained continence. There was improvement in 4 patients; a rate of (4.8%).Failure was recorded in 2 women; a rate of 2. 4%. No post-operative troubles were recorded.

Conclusion: By mending the torn posterior wall of the internal urethral sphincter, Urethro-raphy; and fortifying it further by fixing longitudinally a vaginal graft, Urethro-plasty, the integrity and strength of the sphincter are restored. The sphincter, thus regains its ability to resist sudden increases of intra - abdominal pressure. There were no relevant postoperative complications.

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Introduction
Stress Urinary Incontinence, Detrusor Instability, and Mixed-type of Urinary Incontinence, though widely spread with nasty effects on the quality of life (QOL) of many women, its pathogenesis has not been well understood nor universally accepted. Furthermore, its surgical treatment has a wide spectrum of different types of operations,
Urinary continence depends on 2 main factors, one inherent and one acquired:

1. The inherent factor is the presence of an intact and strong internal urethral sphincter, 
   *(figures 1, 2, 3 & 4).* The internal urethral sphincter is composed of a cylinder of a compact 
   sheet of collagenous and elastic tissues, extending from the bladder neck down to the 
   perineal membrane. The collagenous tissue cylinder is lined by urothelium. The muscle fibers 
   lie on, and intermingle with the collagen fibers in the middle part of this compact collagenous 
   tissue cylinder, with the collagen and elastic fibers extending beyond the muscle layer. The 
   muscle fibers are connected with the detrusor muscle above. The collagenous and elastic 
   tissues give the internal sphincter its high wall tension and hence the high urethral closure 
   pressure. The muscle fibers, controlled by alpha sympathetic activity (T10-L2) are 
   responsible for opening and closing the urethra.

2. The acquired factor: is an acquired behavior gained by learning in early childhood how to 
   maintain a high alpha sympathetic tone at the internal urethral sphincter keeping it closed all 
   the time until voiding is needed or desired.

SUI, DI, and Mixed-type of urinary Incontinence are caused by weakness of the internal urethral 
spincter. The weakness is mostly due to traumatic injury of the internal urethral sphincter causing 
rupture, and/or split of the collagenous tissue cylinder, the essential constituent of the internal 
sphincter. The torn weak internal urethral sphincter with a lower urethral closing pressure will, on 
sudden increases of intra-abdominal pressure, intra-vesical pressure, give way, with resultant 
leakage of urine. Leakage of urine will induce a rapid reactive sympathetic activity will increase the 
sympathetic tone at the internal urethral sphincter preventing further loss of urine. Other causes of 
weakness of the internal urethral sphincter include atrophy, and degeneration of the collagenous 
tissue caused by other factors, e.g., infection, senility, and/or estrogen deficiency. The traumatic rupture may affect the whole length of the sphincter or it may affect mainly the upper 
part of the internal urethral sphincter, or mainly the lower part of the sphincter. *(figures, 5-12).* The 
rupture and its extent can be clearly demonstrated by imaging, using trans-vaginal three-dimension 
ultrasound (3DUS), and magnetic resonance imaging (MRI). Three-dimension ultrasonic examinations 
of patients with SUI show the rupture in the wall with irregular thickness, with areas of echo-lucency 
denoting defective wall. The urethral lumen is open and irregularly dilated due to weakness of the 
wall. The extent and the site of the damage in the internal sphincter wall will determine the type and 
the degree of the urinary incontinence, and the morphological changes seen in the urethra on 
imaging. When the rupture affects mainly the upper part of the internal urethral sphincter this will 
leads to detrusor instability alone or to a mixed type of urinary incontinence, DI+SUI. With sudden 
increases of intra-abdominal, intra-vesical pressures, urine is forced into the upper weak part of the 
urethra stimulating detrusor contractions. Morphologically the weak upper part will lead to funneling 
of the bladder neck with false impression of urethral hyper mobility, axial rotation of the urethra, and 
descent of the bladder neck below the pelvic floor.

When the rupture affects mainly the lower part of the internal urethral sphincter, this will lead to 
“genuine stress urinary incontinence”. In such condition the upper part of the sphincter is more 
intact and narrow, while the torn lower part is wide and dilated, appearing on 3DUS as a “flask 
shape”. If the whole length of the internal urethral sphincter is damaged this will lead to a mixed 
type of incontinence which is more prevalent. The urethra would appear irregular in shape, collapsed 
with apparent shortening. Imaging by magnetic resonance, MRI show the same findings seen by 
3DUS; the normal thick cylinder of the internal urethral sphincter in continent women, and the torn
sphincter in patients with incontinence, (figures, 3-10).

A new operation “urethro-plasty” is innovated to treat SUI, DI, and mixed types of urinary incontinence. It is a vaginal operation, which depends on identifying the rupture in the wall of the internal urethral sphincter and mending the torn wall with simple interrupted sutures, Urethro-raphy.

Furthermore, in order to fortify the internal urethral sphincter, a rectangular piece of the anterior wall of the vagina about 2x5 cm. is cut and put on the repaired wall, and fixed longitudinally, to cover the finely mended sphincter wall. In addition, to the mechanical role it plays, it acts as an autologus source of collagen for the torn internal urethral sphincter. It, also, separates it from the overlying repaired anterior vaginal wall. It is fixed in place with three or more stitches. The anterior vaginal wall is then closed over the corrected, fortified internal urethral sphincter.

The objectives of urethro-plasty are to reconstruct a strong internal urethral sphincter by finely mending the rupture, Urethro-raphy; and to re-enforce the wall; and to provide an autologous source of collagen over the torn weak part, by putting and fixing longitudinally a rectangular piece of the vagina over the rupture. It also, separates the mended, fortified sphincter wall from the overlying anterior vaginal wall. We aim by such procedure, to restore a strong intact internal urethral sphincter, which can resist sudden increases of intravesical pressure.

Objectives:
This paper reports and evaluates the results of urethro-plasty operation in the surgical treatment of SUI, DI and mixed type of urinary incontinence soon after surgery and for up to twelve months of follow up.

Patients and Methods:
All patients in this study gave an informed consent to the operation, and the study was approved by the local ethics committee. Eighty four patients suffering from SUI, DI, and mixed-type of urinary incontinence were included in the study.

Preoperative assessment:
All 84 patients had been evaluated at the urogynaecology clinic. Evaluation included a special questionnaire that inquires about lower urinary tract function and its social impact. The questionnaire ends in identifying either stress urinary incontinence, detrusor instability or mixed type of incontinence. Frequency and nocturia were defined as voiding more than seven times during the day and more than once during night respectively.

Following recruitment, each patient was asked to keep a voiding diary to assess the severity of the leakage, and to monitor the results in the pre-operative and the post-operative follow up period.

Then, physical examination, measurement of any residual urine, urinalysis and tests for bacteriological culture and sensitivity were done.

Urodynamic studies, namely cystometry, urethral pressure profile, stress cysto-urethral pressure profilometry and leak-point pressure were done before surgery and after surgery at the follow up periods. Three-Dimension Ultrasonic assessment of the internal urethral sphincter was done for each patient using trans-vaginal route by a vaginal probe multi-frequent 5-7.5 MHz, Kretz 530 machine. Also magnetic resonance imaging (MRI) was done in some patients to confirm the rupture in the internal urethral sphincter wall and its extent. (figures, 3-10). Urethro-plasty operation was done for each patient, (figures, 13-17).

The Urethro-plasty operation had been explained to the patient and every patient gave a written consent before surgery. General or regional (spinal or epidural) anesthesia is used. The urethro-plasty operation entails dissecting the anterior vaginal wall separately from the posterior wall of the urethra, visualizing the rupture in the internal urethral sphincter and its extent. It is important to dissect the urethral wall clearly free from the vaginal wall and not to dissect through the urethral wall. When clearly dissected, the urethral wall would be obvious with the rupture nicely demonstrated either affecting the whole length of the sphincter or mainly part of it. The repair is done in the torn collagenous tissue cylinder mending the rupture with fine slowly absorbed suture material, this is achieved by placing about ten interrupted stitches. A good "bite" of the torn edges of the collagenous tissue cylinder is taken and sutures are tied with enough strength to bring the torn edges together, Urethro-raphy. After carefully mending the torn wall, a rectangular piece of the anterior vaginal wall, about five cm. long and two to three cm. wide is cut from the dissected anterior vaginal wall, and put longitudinally and fixed on the repaired mended internal urethral sphincter suture line. Usually three stitches, one at the top, one at the bottom, and one in the middle are enough to fix the strip of the vagina on the mended internal urethral sphincter (figure 17).

The anterior vaginal wall is then repaired over the mended and re-enforced internal urethral...
sphincter. No harm is done to the muscle fibers and no narrowing of the urethral lumen, as we do not put plicatory stitches, and so no voiding troubles are noticed after surgery (figures, 13-17).

A Foley catheter is fixed and a vaginal pack is applied for 24 hours, and then both are removed.

Postoperative care:
The catheter and the vaginal pack were removed on the second postoperative day. Patients were allowed to void freely for one day and discharged with an outpatient appointment after 4 weeks, 6 months, and 12 months. During post-operative follow up the patient is assessed clinically, by 3DUS examination and by urodynamic studies.

Postoperative evaluation includes:

- Subjective assessment was done by recording symptoms, assessment of urinary incontinence, SUI, DI, or both, frequency, nocturia, and any voiding troubles.
- Subjective cure is defined as no urine loss on provocation. In addition, the patient should not have any voiding problems, e.g. urine retention, urge nor residual urine, more than 50 ml.
- Objective cure depends on clinical, urodynamic, and 3DUS assessment.
- There should no demonstrable urine leakage on coughing, significant increase in urethral closure pressure and bladder capacity, no significant detrusor contractions during filling the bladder, an increase of the level of first sensation to void, correction of the transmission ratio to more than one, elevation of abdominal leak-point pressure and reduction of post voiding residual urine to less than 50ml. On 3DUS there should be disappearance of defects with the appearance of compact thick wall, the restoration of the urethro-vesical angles and correction of the apparent urethral collapse.
- Improvement is defined as marked reduction in the number of leakage episodes, more than 50% the number before the operation, also not having voiding problems. There should significant improvement in the urodynamic and 3DUS parameters. Failure is defined as post operative leakage episode more than 50% the number before the operation. Urodynamic and 3DUS parameters are not improved significantly.
- The statistical methods employed were the mean, standard deviation, and repeated measure with ANOVA test analysis with its post Hoc test using Statistical Package for the Social Science (SPSS) version 10 with a level of significance of 5%.

Results:

- (Table 1 and figures 18 &19)
- The mean age of the patients was 52.0 years, S.D. 5.8 a range from 38 to 64 years.
- The mean parity was 6.5, S.D. 1.7, a range from 3-10.
- The mean body mass index is 29.3, S.D. 2.24, a range from 24.7to 36.0
- All patients needed pads, mean 7 pads per day, S.D. 1.56, a range from 5 to 12 pads per day.
- Assessment of the condition of each patient after surgery is done by the subjective, objective, urodynamic tests and the 3DUS assessment described before.
- Using these subjective criteria, in addition to objective clinical signs, 3DUS, and urodynamic parameters; 78 patients, (92.8%), gained continence successfully.
- There was improvement in 4 patients from the 84 patients a rate of (4.8%).
- Failure was recorded in 2 women, a rate of (2.4%).
- As seen in the table, there has been high cure rate and improvement as proved by subjective and objective parameters. The urodynamic parameters improved significantly. The first desire to void increased from 92.11 S.D.6.98 ml. water to 143.64 S.D. 4.30 and remained high for the whole follow up period. The urinary bladder capacity almost doubled, increased from 203.3 S.D.10.85 to 426.88 S.D.15.41 ml. The urethral pressure increased significantly from 44.36 S.D.8.32 cm. water to 71.90 S.D.3.88 and persisted at the high pressure all through. The functional length of the urethra increased from 22.29 S.D.1.28mm. to 33.60 S.D.1.62mm. the abdominal leak point pressure increased significantly from 54.6 S.D.9.45 to 159.48 S.D. 5.10 cm water. This significant improvement persisted along the follow up periods.

Discussion

Stress urinary incontinence, detrusor instability, and mixed type of incontinence had been big problems to manage. So many different trials to understand the pathogenesis of the incontinence,
and many different operations are introduced to treat such ambiguous troublesome conditions. We claim that urinary incontinence is due to a weak defective internal urethral sphincter.

Weakness of the sphincter is due to an injury to the collagenous tissue cylinder, the essential constituent of the internal urethral sphincter and which gives it the high wall tension necessary to create the high urethral closure pressure. The most common cause of the defect is traumatic rupture, and/or split of the collagenous cylinder. Other causes include atrophy, and degeneration caused by other factors, e.g., infection, senility, and/or estrogen deficiency.

Weakness of the internal sphincter would reduce the wall tension and subsequently the urethral closure pressure, so that sudden increases of the intra-abdominal pressure would overcome the weak sphincter leading to leakage of urine. This leakage of urine will initiate a quick reactive sympathetic activity that increases the internal sphincter tone preventing further leakage.

Collagen is the most abundant protein in humans. Collagen fibers are usually found in bundles of fibers and provide strength to the tissues. Each fiber is made up of fibrils, chemically it has a high content of hydroxy-proline and hydroxy-lysine. Many different types of collagen are identified on the basis of their molecular structure. Type I is the most abundant being found in the dermis, bone, dentin, tendons, fascia, sclera, and organ capsules.

Urethro-raphy, a new operation had been innovated to treat SUI, DI and mixed type of urinary incontinence. It is a simple vaginal operation which depends on restoring the normal construction to allow the internal urethral sphincter to maintain urinary continence. It is worthwhile mentioning that Urethro-raphy is different from Kelly, Kelly-Kennedy plication operation in the pathogenesis of the incontinence, the aim of the procedure, the technique of the operation and the post-operative sequel. Kelly and Kelly-Kennedy plication operations aim at elevating the bladder neck to a high retro-pubic position and narrowing the funneled bladder neck by plication sutures. This is done by deeply infolding, plicating and suturing together the adjacent pelvic, sub-pubic and peri-urethral fasciae by several mattress sutures. On the other hand we claim that SUI, DI and mixed incontinence are due to a weak torn internal urethral sphincter. In performing Urethro-raphy operation, the aim is to restore an intact and strong internal urethral sphincter with compact, thick walls with high wall tension. This is achieved by identifying the rupture in the wall of the internal sphincter and mending it by approximating the torn edges together by simple sutures. The false impression of urethral hyper mobility and funneling of the bladder neck is caused by the damaged torn weak wall of the upper part of the internal urethral sphincter. Reconstruction and repair of the torn wall will restore the normal shape and station of the bladder neck and urethra.

In some patients suffering from SUI, the urodynamic studies show high urethral closure pressure at rest. This can be present in cases where there is just splitting of the compact collagenous tissue cylinder, without any observable defective rupture in this compact layer, leaving the internal sphincter with high wall tension at rest. However, on stress, the split weak wall yields leading to leakage of urine. This defect can be better assessed by 3DUS studies.

In Urethro-plasty operation, we further, enforce the mended ruptured internal urethral sphincter by fixing a rectangular piece of vaginal skin on the suture line. In addition to the mechanical support, it acts as a whole thickness skin graft, and is a source of autologous collagen. Also, it separates the mended internal urethral sphincter from the suture line of the overlying repaired anterior vaginal wall. There is no risk of inducing an implantation dermoid cyst because of the absence of glands in the vaginal skin.

We evaluated our patients pre, and post operative by clinical assessment, by urodynamic studies, and by transvaginal 3DUS for up to 12 months. There are highly significant differences in the symptoms, signs, urodynamic, and 3DUS parameters as seen in the figures 18-19, and table 1. The immediate results are encouraging, and in the follow up period, further improvement occurred. This can be explained by later healing of the collagenous tissue cylinder in some patients. The healing of the repaired wall of the internal sphincter is affected by many factors, e.g. by the patient age, the tissues state, its vascular supply, any infection, and the trophic effects of estrogen. Senility and hormone deficiency weakens the collagenous tissue, and this may explain the failure in some patients. In a trial to improve the results, we tried local application of estrogen but we are, still analyzing the results. Theoretically, local estrogen application will promote pelvic tissue healing, as pelvic tissues are hormone dependant, with minimal systemic effects. The dose and the duration of application have to be determined.

Also, it might be worth trying to put longitudinally a tape of synthetic material, e.g. Dacron, Teflon or Proline, instead of the vaginal graft, especially in cases of atrophic vaginal wall.
Urethro-plasty is a simple effective vaginal operation that corrects and repairs the torn wall of the internal urethral sphincter, thus, it restores its integrity and strength. This allows the internal sphincter to perform its physiological function in keeping urinary continence.

**Legend of figures:** (click thumbnails for full-size image)

Figure 1: 3DUS picture showing a normal internal urethral sphincter. The internal sphincter has a thick wall with 3 sono echogenic characters. It extends from the bladder neck down to the perineal membrane.

Figure 2: 3DUS cross section of the normal internal sphincter showing a thick wall with 3 sono echogenic characters mucous membrane, collagenous tissue, and the muscle layer overlying the middle part of collagenous tissue cylinder. Note the compactness of the fibers of the collagenous cylinder, with no rupture or defects in the wall.

Figure 3: MRI picture of a normal continent woman, showing a normal internal urethral sphincter with compact thick wall extending from the bladder neck to the perineal membrane with closed lumen.

Figure 4: MRI picture of a normal continent woman, showing a normal internal urethral sphincter with compact thick wall and a closed lumen as seen by cross section.

Figure 5: MRI picture of an incontinent woman. The internal urethral sphincter is torn and defective mainly in the upper part with funnelling of the bladder neck, and an open dilated
lumen.

Figure 6: The internal urethral sphincter, though torn, is seen in a MRI picture as a collagenous tissue cylinder that extend from the bladder neck to the perineal membrane.

Figure 7: MRI picture of an incontinent woman, showing a torn defective internal urethral sphincter, the upper part showing funneling, and the lower part showing a flask shape.

Figure 8: MRI picture of an incontinent woman, showing a torn defective internal urethral sphincter, as seen on a cross section.

Figure 9: MRI picture of a normal internal urethral sphincter (right) as compared with a torn defective sphincter (left).

Figure 10: MRI picture of a normal internal urethral sphincter as compared with a torn defective sphincter, as seen on a cross section.

Figure 11: Three-D US cross section of a normal internal urethral sphincter
compared to ruptured internal urethral sphincter as seen in 3DUS cross sections.

Figure 12: 3D ultrasonic picture in of patient with SUI grade III. The urethra is dilated, and with irregular outline. The sphincter wall is thin and torn. The upper part is more injured leading to funneling of the bladder.

Figure 13: Rupture in the internal urethral sphincter as seen after dissection of the anterior vaginal wall clearly from the internal urethral sphincter.

Figure 14: The wall of the internal urethral sphincter, adherent, to the anterior vaginal wall is dissected and separated.

Figure 15: Two defects in the internal urethral sphincter as seen after dissection of the anterior vaginal wall clearly from the urethra, one in the midline, the other is oblique and lateral.

Figure 16: Urethro-raphy is being done; the rupture is identified and is being mended.
Fig, 17: A flap from the vagina is put on the mended sphincter longitudinally, and fixed in place by one stitch, two or more stitches to be taken.

Fig, 18: Comparison between first desire to void before urethro-plasty and different intervals after urethro-plasty.

Fig, 19: Comparison between bladder capacity before urethro-plasty and different intervals after urethro-plasty.

Table 1

<table>
<thead>
<tr>
<th>Urodynamic parameter</th>
<th>Before urethro-plasty</th>
<th>3 months after urethro-plasty</th>
<th>6 months after urethro-plasty</th>
<th>12 months after urethro-plasty</th>
<th>Significance (F-test)</th>
<th>Post-Hoc test</th>
</tr>
</thead>
<tbody>
<tr>
<td>First desire to void</td>
<td>92.11 ± 6.98</td>
<td>143.64 ± 4.30</td>
<td>144.12 ± 4.54</td>
<td>145.3 ± 4.43</td>
<td>0.000 **</td>
<td>*</td>
</tr>
<tr>
<td>Bladder capacity</td>
<td>202.3 ± 10.85</td>
<td>426.88 ± 15.41</td>
<td>429.89 ± 14.67</td>
<td>430.8 ± 14.75</td>
<td>0.000 **</td>
<td>*</td>
</tr>
<tr>
<td>U.P.P</td>
<td>44.36 ± 8.32</td>
<td>71.90 ± 3.88</td>
<td>70.90 ± 3.81</td>
<td>72.14 ± 3.84</td>
<td>0.000 **</td>
<td>*</td>
</tr>
<tr>
<td>Max. Ure. clos. pr. / cm. water</td>
<td>22.29 ± 1.28</td>
<td>33.60 ± 1.62</td>
<td>32.70 ± 1.82</td>
<td>34.51 ± 1.63</td>
<td>0.000 **</td>
<td>*</td>
</tr>
<tr>
<td>Functional length of the urethra in mm</td>
<td>54.60 ± 9.45</td>
<td>159.48 ± 5.10</td>
<td>160.48 ± 4.81</td>
<td>159.88 ± 4.66</td>
<td>0.000 **</td>
<td>*</td>
</tr>
</tbody>
</table>

* differences between parameters before urethro-plasty at one hand and parameters at both 3 months, 6 months & 12 months after urethro-plasty on the other hand, but not between any of the post operative data.
References:

19. El Hemaly AKMA, Kandil I. M. Stress Urinary Incontinence SUI facts and fiction. Is SUI a puzzle?! http://hcp.obgyn.net/urogynecology/content/article/1760982/1924472

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