

Tethered vagina syndrome: cure of severe involuntary urinary loss by skin graft to the bladder neck area of vagina

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Abstract: *Background* The tethered vagina syndrome is an iatrogenic condition caused by scar-induced tightness in the bladder neck area of the vagina. The classical symptom is commencement of uncontrolled urine leakage as soon as the patient's foot touches the floor on getting out of bed in the morning. With this condition, the bladder works like a watering can, due to loss of elasticity in the bladder neck area. This situation is somewhat similar to "motor detrusor instability", and so is considered as being incurable. 1990 Petros described a new strategy for treatment. The first step is to free all scar tissue from urethra and bladder neck, the second to increase the tissue in the bladder neck area of vagina, thereby restoring elasticity. *Aim:* To test the efficacy and safety of three procedures which aim to restore elasticity in the bladder neck area of vagina. *Methods:* Between Jan. 2001 and Dec. 2009 we performed a plastic operation in the bladder neck area of vagina, "I-plasty" in 13 patients, a free skin graft in 21 patients, and a bulbo-cavernosus muscle-fat-skin-flap-operation from the labium majus in 85 patients. *Results:* At 6 month review, the cure rate (Urine loss <10 gm during 24 hours) for I-plasty was 3/13 (23%), for the skin graft, 11/21 (52%) and for the bulbo-cavernosus-flap, 68/85 (80%). The mean operating time was 62 minutes (range 41 – 98 min). Exclusively, a tethered vagina repair was performed in 5 patients, and in 114 cases, an entero/rectocele repair was performed at the same time. Blood loss was minimal. The mean hospital stay was 5 days (range 2 – 9 days). All patients were mobile at least 4 hours after the operation. Three patients could not pass urine after extraction of the catheter one day after the operation, and in another, an indwelling catheter was necessary for 1 day. *Conclusion:* The bulbo-cavernosus-fat-skin-flap is the most effective way to cure severe incontinence caused by scarring due to previous vaginal or bladder neck surgery.

Key words : Tethered vagina; Motor detrusor instability; Integral Theory; Martius graft; I-plasty

INTRODUCTION

The 'tethered vagina syndrome' is a iatrogenic, but as yet, not well recognized, condition. It is caused by scar-induced tightness in the middle zone of the vagina. It was described by Petros & Ulmsten in 1990, and again in 1993.¹⁻³ It is not defined as a separate entity by the International Continence Society.⁴ This problem is somewhat similar to 'motor detrusor instability', and may arise in patients with multiple previous operations in the bladder neck area of vagina. The classical symptom is commencement of uncontrolled urine leakage as soon as the patient's foot touches the floor, indeed, often commencing as the patient rolls over to get out of bed in the morning. The patient does not complain of bed-wetting during the night. The symptoms are caused by loss of elasticity in the bladder neck area of the vagina:

the so-called 'zone of critical elasticity' (ZCE), (figure 1). Vaginal examination characteristically describes a very tight anterior vaginal wall, with thick scarring or excessive elevation evident in the area of bladder neck, (figure 2). On ultrasound, no significant movement, funnelling or opening out of bladder neck is evident during straining. Because scar tissue contracts with time, it may present many years after vaginal repair or bladder neck elevation. The anatomical basis of this operation resides in the Integral Theory,^{5,6} which states that adequate elasticity is required in the bladder neck area of the vagina so as to allow the opposite muscle forces to operate independently of each other, fig 1. The aim of this study is to prospectively test the validity of three different operations,¹⁻³ all of which aim to restore elasticity in the bladder neck area of the vagina.

MATERIALS AND METHODS

Prospective observational studies were performed to prove the efficacy and safety of three separate surgical procedures. The study was based on 119 patients with the above mentioned problems due to at least two bladder neck operations in the past. All patients had undergone hysterectomy. Between Jan. 2001 and Dec. 2009 we

performed in 13 patients an I-plasty, in 21 patients a free skin graft and in 85 patients a bulbo-cavernosus-muscle-fat-skin-flap from the labium majus. All patients were examined pre- and postoperatively, and operated by the first author. A follow up was performed 5-7 days, 6-8 weeks and 6 month after the operation.

Mean was 65 years (range 42 to 80), mean weight 81 kg (range 61 -105), the mean number of previous bladder neck operations was 3.4 (range 2-11), parity: mean 2.6 (range 1 -5). Mean urine loss during the 24 hour pad test was 453 ml (range 175 – 1330).

All patients presented symptoms of sudden uncontrolled urine loss on getting out of bed, or getting off a chair. Urine began running uncontrollably immediately the patient's foot touched the floor. All were tested pre-operatively with urodynamics and pre- and post-operatively with vaginal ultrasound and 24 hour pad test.

Preliminaries

Whatever the technique used to restore elasticity, it is essential to dissect the vagina from the bladder neck and urethra, and then to free all scar tissue from urethra' bladder neck ('urethrolysis') and pubic bones.

The I-plasty-operation was performed in 13 patients with a co-existing cystocele. I-plasty aims to increase the volume of tissue in the bladder neck area of the vagina, thereby restoring elasticity (figure 3). To reach this aim a vertical full thickness incision was made from midurethra to at least 3-4 cm beyond bladder neck. The vaginal skin was dissected off the scar tissue and was extensively mobilized, forwards to the edges of the vaginal hammock, backwards as far possible right down to the hysterectomy scar, and as laterally as possible.

The freed tissue was brought into the ZCE and sutured transversely with interrupted sutures.

The skin graft operation, (figure 4), was performed in 21 Patients. After a full thickness transverse incision in the area of bladder neck the vagina, urethra and bladder neck were freed from the scar tissue. This resulted in opening

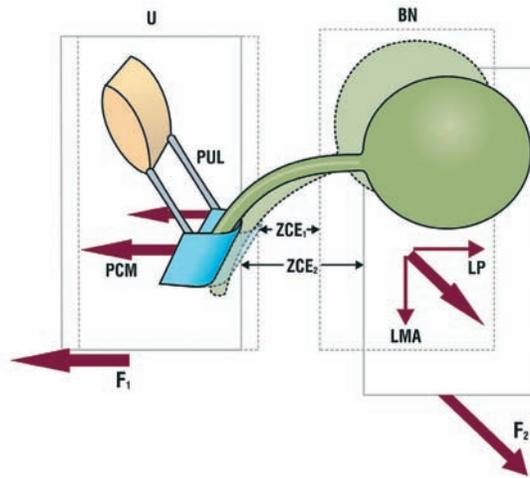


Fig. 1 – The Zone of Critical Elasticity (ZCE) $ZCE_1 = ZCE$ at rest; $ZCE_2 = ZCE$ during effort or micturition. Adequate vaginal elasticity at ZCE allows the oppositely acting urethral (U) and bladder neck (BN) closure mechanisms to operate. F_1 represents the forward acting vector which stretches the vaginal hammock forwards to close the distal urethra (“urethral closure mechanism”). F_2 stretches the proximal urethra backwards and downwards against the pubourethral ligament “PUL”, to close it (“bladder neck closure mechanism”). A scar at ZCE “tethers” the oppositely acting muscle vector forces, so that on application of a strong prolonged force, such as occurs on getting up out of bed in the morning, F_2 overcomes F_1 , and the posterior wall of the urethra is pulled open, exactly as occurs during micturition. Coughing exerts a short sharp force. If there is just sufficient elasticity remaining at ZCE, F_1 and F_2 may be able to operate separately, so no urine lost on coughing. However, if the vagina just behind the scar is gently stretched backwards by Allis forceps, all the residual elasticity is removed from ZCE, and urine is now lost on coughing. PCM = m. pubococcygeus; LP=m. levator plate; LMA=m. longitudinal muscle of the anus. F_2 represents the resultant force of the LP/LMA vectors.

up of a large gap. Care was taken to effect haemostasis. A full thickness skin graft approximately 6x4 cm was taken from the lower abdominal wall. After removal of underlying fat the graft was applied to the bladder base using several ‘quilting sutures’. The graft was then trimmed as necessary, and sutured to the adjacent vaginal skin with interrupted 00 Vicryl.



Fig. 2 – Thick scar tissue in the bladder neck area of vagina typical of the “tethered vagina syndrome”.

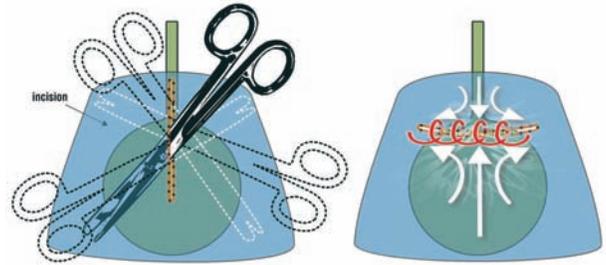


Fig. 3 – I-plasty operation A vertical incision is made in the bladder neck area of vagina. The vagina and urethra are extensively mobilized off the adjoining tissues and pelvic side wall. The incision is sutured horizontally, thus introducing fresh tissue to the site.

“Skin-on” Martius flap graft (figure 5). In 85 patients the large gap after scar dissection was covered with a bulbocavernosus-muscle-fat-skin-flap from the labium majus. A 5x3 cm ellipse of vulval skin was created over the labium majus and transferred with underlying fat and muscle through a tunnel into the dissected area. The tunnel must be sufficiently large to avoid constriction of the vascular pedicle. The graft was attached to the adjacent vaginal skin.

RESULTS

The cure rates (Urine loss <10 gm during 24 hours) were, for I-plasty 3/13 (23%), for the skin graft 11/21 (52%) for the bulbocavernosus-flap and 68/85 (80%). The mean operating time was 62 minutes (range 41 – 98 min).

Exclusively a tethered vagina repair was performed in 5 patients, and in 114 cases, an entero/rectocele repair was necessary at the same time. No serious bleeding was observed.

The mean hospital stay was 5 days (range 2 – 9 days). All patients were mobilized at least 4 hours after the operation. Three patients could not pass urine after removal of the catheter one day after the operation and further permanent catheter was necessary for another 1 day.

DISCUSSION

The International Continence Society (ICS) considers that ‘Motor Detrusor Instability’ is not surgically curable, and beyond treatment with anticholinergics (ineffective for this condition), little can be done to help patients with such a condition. There is no ICS definition for the ‘tethered vagina

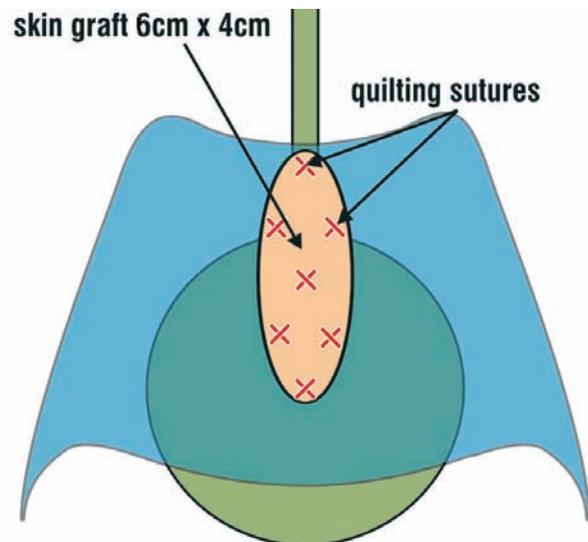


Fig. 4 – Skin graft to bladder neck area of vagina is attached by quilting sutures.



Fig. 5 – Martius skin graft . The graft is brought through a hole in the lateral vaginal wall. The skin is sutured to the edges of the vagina. The wound from the site of the graft is to the left. This is sutured with subcuticular 00 Dexon sutures

syndrome'. The 'tethered vagina syndrome'¹ is conceptually similar to "motor detrusor instability", in that the urine loss is massive and uncontrolled. As the mechanism for opening out the posterior urethral wall is mechanical, urgency is frequently not found with this condition. The cause is iatrogenically induced fibrosis in the bladder neck area of the vagina. It is far more common in regions where surgeons are taught to remove significant amounts of vaginal skin during vaginal repairs.

The explanation for cure of this condition by restoration of elasticity in this area may be explained by reference to a previously described hypothesis^{5,6} (figure 1): there are separate urethral and bladder neck closure mechanisms. In the former, forward vectors stretch the underlying vagina on each side to close the urethra from behind. In the latter, backward/downward vectors stretch the proximal vagina and bladder base backwards and downwards to close off the bladder neck. Adequate elasticity is required for these separate movements. If fibrosis occurs at this critical point then the opportunity for independent movement is lost and the stronger posterior force overcomes the weaker anterior force. As a result the urethra is forced open (figure 1).

Often there is very little stress incontinence. The reason is that cough creates short sharp fast switch contractions, and there may be just sufficient elasticity at ZCE to prevent urine leakage on coughing. Getting out of bed in the morning stretches ZCE far more as the pelvic floor contracts to support all the intra-abdominal organs. The classical symptom is commencement of uncontrolled urine leakage as soon as the patient's foot touches the floor. Often there is no urgency, as the cause is mechanical: a scar at ZCE 'tethers' the more powerful backward forces 'F2' (figure 1) to the weaker forward forces 'F1', so the bladder is pulled open as in micturition.

To cure this condition the aim must be to restore elasticity in the bladder neck area of the vagina, the 'zone of critical

elasticity' (ZCE), so that 'F1' and 'F2' can act independently of each other. As a first step, it is essential to dissect the vagina from the bladder neck and urethra, and to free all scar tissue from urethra, bladder neck and pubic bones ('urethrolysis').

There must be no scar tissue anchoring the bladder neck to the pelvic side wall.

The second step is to bring fresh tissue to the bladder neck area of the vagina to restore elasticity, and prevent new scar creation in this area. Our results demonstrate that the I-plasty operation cures less than one fourth of the patients. Therefore we decided not to continue with this method in cases where there is obvious tissue deficit. It is still the simplest technique but only indicated if there is no tissue deficit. The I-plasty works very well in patients where the cause is excessive bladder neck elevation, for example, after a Burch colposuspension. If there is a severe shortage of tissue or a large gap after dissection, this defect has to be covered with a skin graft or a flap.

The results with free skin graft are much better than with I-plasty, but a cure rate of about 50% is still not convincing. A free graft is problematical because there is no blood supply.

Therefore up to one third may not 'take', or the graft may shrink excessively.

The bulbocavernosus-flap operation is technically more challenging, but brings its own blood supply. This is in our opinion the explanation for the high cure rate. Using this technique it is very important not to compromise the blood supply of the graft. Therefore the pedicle must be thick enough to prevent too much compression to the vessels in the pedicle, and the space created in the lateral vaginal wall for passage of the graft must be adequate.

CONCLUSION

The results appear to sustain the hypothesis that adequate tissue elasticity is required for the separate function of the bladder and urethral the closure mechanisms.^{5,6} Application of a muscle-fat-flap to the zone of critical elasticity after scar dissection restores the tissue elasticity in the bladder neck area of vagina and continence in about 80% of patients.

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