

A review and critical analysis of historical operations for cure of urinary stress incontinence.

Part 2- abdominal sling operations

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Abstract: Aim: To critically analyse the anatomical basis of historical abdominal sling operations for the cure of urinary stress incontinence (USI). **Methods:** Historical abdominal sling operations for cure of USI were critically analyzed as regards their modus operandi from an anatomical perspective using a 15 point system: 1. Minimally Invasiveness. 2. Ease of Performance. 3. Built-in Safety of the procedure. 4. Short term complications. 5. Long term complications. 6. Applicability to obese patients and those with poor tissues. 7. Applicability to patients with previous operations for stress incontinence. 8. Blood loss. 9. Length of operation. 10. Early discharge from hospital. 11. Urinary Retention. 12. Long-term Continence. 13. Early resumption of normal activities. 14. Anatomical damage. 15. Physiological mode of action of the operation. **Results:** A critical analysis is given for abdominal slings using both natural tissues such as rectus abdominis sheath, or plastic inserts. Benefits and complications such as post-operative pain and urinary retention are detailed. **Conclusions:** The main obstacle to abdominal slings becoming day-care operations revolve around the obstruction of urination by the positioning of the sling at bladder neck. This prevents the funneling required to reduce intraurethral resistance to urine flow, potentially causing obstructed micturition. Excess pressure on the overlying stretch receptors may cause de novo urgency. Finally, the large incisions required to access the operation site may cause organ damage, hemorrhage and thrombosis.

INTRODUCTION

In 1983, Ingelman-Sundberg,¹ stated that there were >100 surgical operations described for the cure of stress incontinence. We can reasonably conclude that no one operation fully addresses the problems and complications associated with surgical cure of this condition. We have previously reviewed historical vaginal operations. In the following sections, an analysis is made of abdominal sling procedures.

Evaluation with reference to a 15 point table is made. The most common variants of these operations are described. It will be assumed that the same limitations of the category of sling operations applies to a greater or lesser extent also to the variations. Criticism will be based on logical analysis with reference to known anatomy, physiology etc, or on references in the literature. Important papers will be quoted in detail. An attempt will be made to evaluate each operation as to its modus operandi, referring specifically to the hypothesis.

Suggested criteria needing to be filled by the ideal operation

- (1) Minimally Invasiveness.
- (2) Ease of Performance.

This allows the operation to be performed by less skilful surgeons. It also reduces the operating time and the potential complication rate.

- (3) Built-in Safety of the procedure.

In a methodological sense, the operation must have an in-built safety margin, if possible to avoid penetrating the various adjacent organs and to diagnose any perforations occurring. As part of this process, one should bear in mind the complicating presence of scar tissue from previous operations, and the fact that anatomical variations, especially of the ureters, not infrequently occur.

- (4) Short term complications.

There are complications associated with general anaesthesia, the presence of intercurrent disease (often a problem due to the high incidence of incontinence in the aged), thrombosis, haemorrhage, lung complications, and infection, especially as the operation is conducted in an area in-

habited by the bladder, urethra, ureters and the blood vessels of the vesical plexus.

- (5) Long term complications.

Retention of urine is dealt with separately, but complications such as enterocele formation and dyspareunia, pain at the site of artificial fibre insertion in the rectus sheath, herniation through the rectus sheath in, for example, Aldridge sling operations. Each operation has its specific complications. These complications will be attributed to the anatomical distortions associated with bladder neck elevation procedures.

- (6) Applicability to obese patients and those with poor tissues.

All suprapubic operations are difficult in obese patients, the open operations being particularly so. In the elderly patient, the diabetic, the obese with poor tissues where the integrity of the operation hangs on the suturing of tissue to either bone or ligament there is a risk of the suture tearing out of the tissue, usually the vagina.

- (7) Applicability to patients with previous operations for stress incontinence.

Previous operations tend to form fibrosis and even if the urethra is freed from the fibrotic tissue.

- (8) Blood loss.

There are very few reports in the literature which measure the amount of blood loss. The importance of blood loss relates to an accompanying increased incidence of thrombosis, infection, risks from transfusion and, of course, greater morbidity and increased length of stay in hospital. As an indication of the importance of this parameter, Stanton et al² recorded an average blood loss in the Burch operation of 377ml, rising to an aggregate of 858ml with hysterectomy.

- (9) Length of operation.

This parameter partly impinges on 1), 2), 4), 6) and 8) above, and there is also wide variation here, depending on the patient and the surgeon. Certain operations, however, are inherently more complicated than others. For example, there is much more involved in an Aldridge sling or a Zacharin operation than there is in a Burch or Marshall-Marchetti operation.

- (10) Early discharge from hospital.

Over and above the economic factor of saving the cost of hospital days, an operation which allows early discharge almost certainly is a far more efficient, less traumatic and more desirable operation.

(11) Urinary Retention.

"The most vexing problem has been incomplete voiding", Hodgkinson,³ referring to the complications of retropubic urethropexy. This needs to be stated as a specific complication. It is very discomforting to the patient, adds considerably to the cost of the operation and greatly predisposes to urinary tract infection.

(12) Long-term Continence.

All operations have an increasing failure rate with time, Spencer.⁴ Very few series have properly defined objective criteria for assessment of post-operative results, Spencer.⁴ Thus this parameter has to be carefully examined. Many operations have very good short term results which, unfortunately, are not borne out when the patient is reassessed after two years.

(13) Early resumption of normal activities such as housework, intercourse, sport. The operation can be painful and may require up to two weeks lying in bed with an indwelling catheter.

These are some of the most serious obstacles to young women with families undertaking a vaginal repair operation.

(14) Anatomical damage.

It is important to avoid any damage which could hinder a successive operation should the primary operation fail. Specifically, fibrosis to the urethra and bladder neck must be avoided in the methodology of all operations, Tanagho.⁵ This, of course, is not always possible, but certain operations do appear to be less likely to cause this problem, especially if large segments of vagina are excised.

(15) Physiological mode of action of the operation.

The central criterion here will be whether there is anatomical distortion following operation, on the traditional basis that function follows restoration of normal anatomy.

The historical development of the sling procedure.

In 1907 Giordano used a part of a double gracilis muscle transposed beneath the bladder neck to give support and cure incontinence in a 7yr old patient with spina bifida.¹

In 1910 Goebell⁶ described an operation in which he dissected free the pyramidalis muscle from the anterior abdominal wall, brought it down posterior to the symphysis, through the Cave of Retzius, to form a sling beneath the urethra near the bladder neck. He reported two successful cases in which no other type of procedure would have been feasible, and continence was established. An obvious shortcoming of this technique was the inconsistency, or even congenital absence, of the pyramidalis muscles.

In 1914 Frangenheim⁷ utilized what portion of the pyramidalis muscles were present, but with an attached strip of the anterior abdominal fascia. He performed an operation on a male. The strap was dissected as one continuous strip and slung underneath the urethra as a loop and reattached to itself at its origin.

In 1917 Stoeckel⁸ combined the use of pyramidalis muscle and the strip of fascia from the anterior abdominal aponeurosis, making the operation virtually independent from pyramidalis muscle. The superior end of the fascia was split, passed retropubically and plicated beneath the urethra with the appropriate tension. He reported success in two difficult cases, one with previous successful repair of a vesicovaginal fistula and the other with a large cystourethrocoele. The operation subsequently became known as the Goebell Frangenheim Stoeckel technique.

In 1919 Solms⁹) used the distal ends of the round ligaments. Thompson¹⁰ used bilateral fascial strips from the rectus muscle .

In 1932 Norman Miller¹¹ modified the technique of what was now called the Goebell/Frangenheim/Stoeckel operation, by bringing the developed musculofascial sling of the pyramidalis and anterior abdominal aponeurosis anterior to the symphysis and beneath the urethra. His rationale was to try and avoid the haemorrhage often encountered in the retropubic space, especially from the perivesical plexus of veins. Unfortunately, he encountered similarly troublesome bleeding at the region of the clitoris. As well, he had difficulty in achieving the proper angle of support necessary at the region of the posterior third of the urethra.

Price (1933) again modified the procedure and obtained a cure of urinary incontinence in a young girl who had no bladder sphincter control because of congenital deformity of the lower spinal cord, sacrum and coccyx.¹² He used a sling of fascia lata, diverted it below the urethra as a sling and attached it to the other rectus muscle fascia. This was a more logical modification, as the attachment to the rectus muscle fascia was able to achieve a constant and equivalent tension underneath the urethra.

In 1942 Aldridge¹³ made transverse abdominal incision on both sides, dissected out strips of abdominal aponeurosis approximately 1cm wide, parallel to Cooper's ligament. The medial ends were left attached and the distal ends were brought down, either lateral to the rectus muscle valleys or actually passed through them beneath the urethra and sutured together in the midline with silk. This operation had two problems:

(1) there was no way to adjust the post-operative tension below the urethra, so that a fair amount of guesswork was involved in how much looseness to leave to take up the slack when the patient stood up;

(2) a defect was left in the anterior abdominal wall on both sides, which predisposed to hernia formation.

In 1948 Millen & Read¹⁴ again modified Aldridge's technique, by dissecting two long strips, leaving them attached at the lateral ends, pulling them underneath the urethra and attaching them both to the opposite abdominal wall. This operation had the singular disadvantage of having to be performed blind in the suburethral area.

In 1949 Shaw¹⁵ devised a sling which consisted of passing autogenous fascia beneath the urethra. He fastened the free end to holes drilled in the pubic symphysis. He reported 35 successful operations out of 51 cases. One patient died.

Barns (1950), used the uterine ends of the round ligaments to form a sling in 6 patients with "good results".¹⁶

Ball & Hoffman (1963) did a combined approach with retropubic and vaginal approach, consisting of plicating the bladder.¹⁷ Narik and Palmrich (1962) used strips of external/muscle fascia.¹⁸ Havlicek (1972) used a lyophilised dural sling. Beck and Lai (1982) used a fascia lata sling .¹⁹ Poliak et al (1984) used tendon from palmaris longus muscle (6 patients only) .²⁰

Other (plastic) sling techniques: Bracht (1956) , performed a nylon sling;²¹ Anselmino (1952), used a Perlon sling;²² Zoedler (1961), used a nylon sling.²³

Aldridge sling operation - (1957)

McLaren (1968) reported that the major post-operative complication was delay in micturition.^{24,25} Transection of the urethra was reported. Initial success rate was 87%, falling to 71% in periods of up to 16 years. Patterns of micturition were altered, as 16 out of 48 patients had to stoop to allow the bladder to empty completely.

McLaren also quotes a case whereby a sling operation made the patient continent when she was upright but if she bent down, e.g. when gardening, then urine escaped involuntarily.

Comment

The fact that 16 out of 48 patients had to stoop to allow the bladder to empty completely implies that a secondary sphincteric action, stretching upwards of the sling by the rectus abdominis may be part of the mode of action of the Aldridge sling operation. This is not, of course, under neurogenic control.

Similarly, Beck and Lai (1982), in reviewing 88 cases²⁶ noted a principal complication of delayed voiding times (average successful voiding time 40.7 days). They felt that the cause was one of detrusor muscle hypotonia, usually associated with previous severe incontinence, interference with funnelling of the bladder neck, which is necessary for voiding, and excessive urethral kinking at the sling site when the patient strained to void. Detrusor overactivity, some of it appearing for the first time, was considered to be a major cause of operative failure. Other complications were DVT, pulmonary atelectasis, total inability to void, and wound infection. Cure rate was 88.6%. They considered that the modus operandi of the operation is the provision of support to the bladder base and urethra, replacing the poor tissues which prevented this pressure equalization in the first place.

Parker et al (1979) use a variation in their technique.²⁷ They dissected away the pubocervical fascia of the anterior vaginal wall, sutured it over the bladder and urethra and then placed a fascia lata strap connecting up to the anterior abdominal wall. Their mean average time for urination was 12 days and they felt that the mechanism of action was to lift up the bladder neck during all Valsalva manoeuvres. They agree with Ridley (1966) that the chief error of a sling operation is placing too much tension on the sling, and that there is a problem in trying to have an objective means of measuring sufficient tension in the anaesthetised patient, because "we do not feel that intra-operative urethral pressure profiles with the patient anaesthetised and recumbent, or mechanical determination of tension on the sling under the same conditions, can be directly related to forces generated by the conscious patient in the upright position".²⁸ McGuire (1976). Intra-operative pressure determination is, however, an essential part of McGuire's Technique, (1976).²⁹

Williams/Telinde operation

Mersilene ribbon 5mm in width was used by Williams and Telinde (1962). They have reported a series of 12 cases but ultimately it was abandoned because of a propensity to transect the urethra. Two out of the twelve cases were reported as having either a suprapubic sinus or abscess sinus. Other complications were retention, standing in order to be able to void. The cure rate was nevertheless high, with nine cases cured and one improved out of twelve).³⁰

Marlex sling operation - Morgan (1985)

A total of 281 patients mostly with multiple failed operations had a suburethral Marlex Sling inserted.³¹ Cure rate: 77.4%. Complications: 7% had sloughing of their urethra. Five per cent had difficulty emptying their bladder; 5% had a new incidence of urgency and frequency; 3% had large haematomas. Other complications included stone formation, late transection of urethra, (1 & 3 years), and, of course, the intra-operative risk of bladder and urethra perforations. The authors suggest that in spite of its complications, this operation may be an acceptable alternative to urinary diversion. Morgan states that no slings have been rejected or removed.

This does not accord with the experience of Barton (1989). Slings were removed in 3/37 patients. Skipper (1977) reported 1/30 removals.³²

Drutz et al (1990): Sixty five women had operations, ulceration of the anterior vaginal wall was present in 4 patients, 1 patient died, success rate with urge incontinence was 75% and stress incontinence 95.3%, residual urine increased from 89mls to 129mls post-operatively.³³ There was a reduction in peak flow. No comment was made as to the number of hospitalization days or as to urinary retention.

Polytetrafluoroethylene suburethral sling procedure (PTFE)

This was performed for the first time and reported by Horbach, Blanco, Ostergard et al in 1988 (34). The material used is a non-absorbable polytetrafluoroethylene which is designed for use as a prosthetic material. The inert, porous microstructure of polytetrafluoroethylene, according to the authors, facilitates tissue incorporation without excessive foreign body reaction, and apparently allows treatment of an infection without graft removal. The authors reported a series of 17 patients with genuine stress incontinence and low urethral closure pressures, documented by urodynamic testing. Patients with a primary diagnosis of genuine stress incontinence and resting maximum urethral closure pressures of 20cm of water or less in the sitting position at maximum cystometric capacity were eligible for this sling operation.

Operative technique was similar to the Marlex sling. The graft was trimmed to 20cm x 1.5cm except for a 3cm x 2.5cm elliptical portion in the centre of the graft. The graft was sutured to the fascia overlying the urethrovesical junction and proximal urethra with two interrupted polytetrafluoroethylene sutures. The tension on the graft was adjusted to create a -5 degree Q Tip angle with the horizontal. Out of the 13 patients who had post-operative evaluation, 3 patients had no history of anti-incontinence procedures. Three others had had an endoscopic suspension procedure. i.e. at least 6 out of the 13 had not had any operation which could have implicated the urethra. Average hospital stay was 6.2 days and the average suprapubic catheter duration was 29.2 days. Two patients required intermittent self-catheterisation. One patient developed a wound seroma after her hospital stay. Despite initial healing, the patient suddenly developed an abdominal sinus tract. Surgical re-exploration showed the tract involved the graft, which was no longer under tension and was therefore removed. Functional urethral length increased from 1.6 to 2.1 cm post-operatively and the maximum urethral closure pressure was found to increase from 11.4 to 36.1 cm. Objective cure was seen in 11 of 13 patients.

PTFE sling

Summitt et al (1992) Results: Ten out of 48 patients required intermittent self catheterization. Six continuing beyond three months, six needed to be removed due to erosion or sinus formation, 62 developed at least one urinary tract infection, 29% demonstrated post-operative bladder instability which half were of new onset. The sling material used was PTFE, i.e. a type of Teflon (35).

Silastic sling

Korda et al (1990) performed this operation for indications which included previous failed bladder neck elevation procedures (13 patients), chronic obstructive airways disease (22 patients) and inability to elevate the vagina (32 patients). Eighty one per cent of patients were cured, 6 patients required self-catheterization and 9% of patients had voiding difficulties twelve months after the procedure. Two patients developed sinus tract, post-operative urinary retention was

common (9 to 99 days). Sixteen patients required release of the sling to establish voiding (36).

Critical analysis

In principle, the above operations are similar to the Marlex Sling operation. It is very hard to justify a sling operation on patients who have had no previous procedure performed, especially as 15%-20% of the patients subsequently need self-catheterization.

The reporting of a seroma post-operatively contrasts with the claim earlier that polytetrafluoroethylene is an inert material. Huland et al (1984)³⁷ reported a 10% incidence of fistulae with a mean recurrence time of 15.3 months using a No. 3 monofilament polyamide suture material. Whereas the sinus formation in the experimental animals in this thesis is at least partly attributed to the dogs' hypersensitivity to braided suture material, the presence of a sinus shows that there is no such thing as an inert suture material. There will always be an instance or an individual where a reaction will occur, Tanagho (1980).³⁸ The fact that the graft was no longer under tension when it was removed is interesting. Almost certainly there was a fibrous tissue reaction around the graft and it has been found in the 2nd author's experimental animal work that the tape lies loosely within the created sinus tunnel.³⁹ In this case, almost certainly the reaction at the suturing to the rectus sheath would have allowed loosening of the tape.

A urethra with low closure pressure has virtually no resistance to leakage in the presence of defective closure mechanisms. Therefore a sling should constrict the bladder neck on effort. McGuire and Lytton attributed low maximal urethral pressures to a fibrotic urethra. In Horbach's series, 11 out of the 13 patients had a hypermobile urethra, suggesting that there was no fibrosis and rigidity. Therefore, it appears, on first glance, that a more dangerous operation was performed for inappropriate indications. The fact that the patient was under general anaesthesia meant that the anterior abdominal wall muscles were relaxed. On waking up and standing up then there would be further elevation of the UV junction due to contraction of the pelvic floor. Chassar Moir, in performing the Aldridge sling operation, used to leave enough space for a small finger to fit in, presumably to allow for this factor, William Garrett (personal communication) (1968). It is well known that the urethra is shortened in stress incontinence and one would expect an increase in functional urethral length, purely from the elevation of the urethra, by the sling. The upward force provided by the abdominal wall tension pulling on the posterior urethral wall by means of a 3cm x 2.5cm hammock per se could increase the intraurethral pressure by decreasing the area below the periurethral striated muscle,³⁹ according to the formula, pressure = force/area .

Absorbable polyglactin mesh for retropubic sling operations in female urinary stress incontinence - Fianu (1983).

Absorbable polyglactin instead of synthetic materials resulted in no tissue rejection in 21 patients observed 4-14 months. Cure was noted in 20 /21 patients.⁴⁰

Porcine dermis bladder sling⁴¹ - Jarvis (1985)

The operative success rate was 78% over a 21 month period. Complications such as postoperative detrusor instability (14%) and urinary retention were in line with other sling operations. Suprapubic cellulitis/weeping usually in the absence of bacterial growth was a feature of this operation.

Critical analysis

A major problem noted repeatedly in this survey is tissue rejection. Use of an absorbable mesh appears *prima facie* to

provide the answer to this problem. However it has been demonstrated earlier (Bailey 1972)⁴² that only plastic creates a permanent scar. Other irritants of a temporary nature (e.g. turpentine, carrageenan) are absorbed over a period of 6 to 12 months. In contrast the porcine dermis sling had a 50% tissue reaction, in spite of having been enzymatically cleaned and depilated. It is possible that this was an allergic type reaction. Nevertheless, the Lyodura sling (a human sling made from dura mater) has very few problems with rejection (1985).⁴³ Interspecies homology of collagens from the same tissue may be 85% to 95%, Peacock (1984). The difference may involve one amino acid base pair in the DNA molecule. The conclusion reached, is that the porcine dermis sling is not homologous, and therefore provokes a tissue rejection.

FIFTEEN POINT ASSESSMENT OF SLING OPERATIONS

(1) Invasiveness.

An abdominal sling is a highly invasive operation.

(2) Ease of performance.

The combination of atrophic tissues, scarring, and the inherent difficulties encountered by operating in a confined space populated by blood vessels ureters bladder and urethra all contained within a few square centimetres ensures that all sling operations require a considerable amount of skill.

(3) Built in safety.

It is not possible to structure these operations to incorporate such a factor. They are by their very nature the most traumatic, and the most uncontrollable in terms of long term complications such as urinary retention, transection, etc. Also, these operations required the most surgical skill and judgment. Nevertheless the sling operations using the patient's own fascia, e.g. in the Aldridge operation do have an in-built advantage over the other operations such as the Williams/Te Linde Mersilene ribbon operation. There is always some "give" in the sling. i.e., the lack of rigidity of the fascia gives the operation an in-built protection factor.

(4) Short term complications.

These may be severe, and include damage to bladder, urethra, ureters, perivesical veins (haemorrhage), infection.

(5) Long term complications.

A wound seroma occurred requiring operative removal of implants, fistulae, urethral stones, transection of urethra, herniation (fascial slings), pain in the scar region.

There is no indication given as to the more subtle complications found with sling operations, such as the quality of micturition, as patients often have to bend over to micturate.

Micturition may come in little drips, often with a squirting action from the bladder. The stream can be cut off mid-way and often has to be restarted.

(6) Applicability to the obese and patients with poor tissues.

These operations, by their very nature are technically difficult operations and also weaken the muscles and fascia of the anterior abdominal wall. If the tissues tore at the site of the artificial tape's attachment to the rectus sheath early in the post-operative period then operative failure is always possible. This is, in fact, highly likely as the shearing force would be quite considerable in an obese patient with poor tissues.

(7) Applicability for patients with previous incontinence.

The results of all the operations indicate that this is an operation of last resort McGuire however, advocates its use in patients with low urethral pressures. Dissecting the urethra and the provision of a constricting sling, would have a use in patients with a fibrotic urethra where all other means of

control of the incontinence had failed, and where urethral constriction is the necessary mechanism of action.

(8) Blood loss.

The average blood loss of 153ml recorded by Horbach, an excellent figure, was the only recording of blood loss for sling operations that I could find in the literature. In selected patients the blood loss may be considerable during sling operation. On this criterion this operation should be inferior to say the Stamey operation.

(9) Length of operation.

Generally, the authors do not state, length of operations, but even with two teams operating above and below, an hour would be a minimum time. Iosif reported times of 1-2 hours for the Zoedler and Lyodura sling operations. Fowler (1986)⁴⁴ reported operating times of 1-3 hours for Marshall Marchetti and Stamey procedures. If correct, however, then we would be looking at up to 4 hours for some sling procedures such as the Aldridge sling, especially in obese patients.

(10) Hospital stay.

As this operation is the most traumatic, with also very high rates of urinary retention, hospital stay is potentially the longest. There are very few references to hospital stay in the literature.

(11) Long term urinary retention.

Requiring self catheterization is a very serious and significant problem with this operation. Horbach (1988) reported 15%, Korda (1990) reported 10%.

(12) The success rate.

This varies between 61% and 94%. It is usually very close to 90% in most series. Hohenfellner and Petri (1980)⁴⁵ state that the success rate depends on patient selection and indication. Incontinence from detrusor contraction is not, however, usually included as a cause of failure. i.e. Stress incontinence is often the parameter assessed.

(13) Early resumption of normal activities.

This operation is the most traumatic, with very high rates of urinary retention. Return to work may take a long time.

(14) Anatomical damage. By its very nature this procedure is the most surgically traumatic. Uncontrolled scar formation is a principal complication with any surgical procedure, Peacock (1984).⁴⁶ Indeed, the fibrotic urethra is considered to be an indication for this operation according to McGuire.²⁹ Morgan is more explicit. He states that prior to insertion of his Marlex sling, the anterior scar in the Cave of Retzius, and the posterior vaginal scar must be released.

(15) Restoration of normal anatomy.

The anatomy is not actually restored in these operations. Morgan³¹ states that the process of elevation per se may cause enterocoele, as in other bladder neck elevation operations. The physiology of return to urinary continence in these operations is still not properly understood. McGuire found an increase in intraurethral pressure post-operatively. Henriksson and Ulmsten (1978)⁴⁷ did not. Both studies found increased cough transmission profile. Almost all authors (Morgan, McGuire, Stanton, Beck, to name but a few), report uninhibited detrusor contractions after this procedure. There is no consensus concerning the modus operandi of the sling procedure. Kinking of urethra is considered a primary mode of action, Beck et al (1982). McGuire demonstrated a drop in urethral closure pressure prior to the onset of a detrusor contraction, indicating that the sling was not a significant cause of obstruction "unless the patient attempted to void entirely by straining". Stanton considers that elevation of the proximal urethra to an intra-abdominal position, plus support of the posterior urethra allowing better pressure transmission are also significant factors. Wheelless et al (1977)⁴⁸ believe that the sling elevates the urethra slightly on increased intra-abdominal pressure,

and also that the intraurethral pressure is raised by elevation of the posterior urethral wall. According to the Integral Theory,³⁹ the sling provides an anchoring point for the proximal and distal urethral closure mechanisms.

Critical analysis

The mode of action of the sling operation as quoted by various authors is that the sling elevates the bladder neck. This may not be strictly correct. It is inconceivable that the fascia lata sling would elevate the urethra precisely at the point where it passes underneath it. Almost certainly fibrous tissue formation results, so that the whole anterior vaginal wall is probably lifted up, although by virtue of the indentation made by the sling, constriction would be applied at the point where it passes under the urethra if the suture was too tight. No detailed studies have been made as to the other modes of action of this operation. It is quite likely that the considerable amount of haemorrhage that is provoked will lead to adhesions, probably between the vagina and the pubic symphysis. As well, there is no mention made as to whether or not the actual sling remains viable. It is highly likely that a necrosis will occur, and an alternative blood supply will form. McGuire's (1976) exclusion of obstruction by referring to a pre-micturition drop in urethral pressure does not make sense if, as seems likely, the drop may be reflexly induced, and if other factors e.g., either smooth or striated muscle contraction are involved as components of urethral pressure. The very high rate of unstable detrusor reported after these operations has been simply ignored by all authors. No explanation is attempted. The intra-abdominal pressure equalization theory cannot in any way explain this phenomenon. Wheelless et al (1977) believe that the sling elevates the urethra slightly on increased intraabdominal pressure, and also that the intraurethral pressure is raised by elevation of the posterior urethral wall. The authors conclude on a strong doubtful note, however, in questioning that if the foregoing were all true, how can cure of congenital defects such as total bladder exstrophy occur with this operation? The alternative explanation, Petros and Ulmsten (1990), is that the levator plate pulls back the vagina and bladder neck and then kinks the urethra at the bladder neck by contraction of the longitudinal muscle of the anus. The sling, therefore, provides a fulcrum point for such "kinking". However, the position of the sling at bladder neck prevents the active funneling required to open out the urethra, a pre-requisite for the exponential fall in intraurethral resistance which allows normal micturition.³⁹ Post-operative urgency associated with bladder neck slings is explained as being caused by upward pressure of sling on the nerve endings of urethra and bladder neck.³⁹

CONCLUSIONS

The main obstacle to abdominal slings becoming day-care operations revolve around the obstruction of urination by the positioning of the sling at bladder neck. This prevents the funneling required to reduce intraurethral resistance to urine flow, potentially causing obstructed micturition. Excess pressure on the overlying stretch receptors may cause de novo urgency. Finally, the large incisions required to access the operation site may cause organ damage, hemorrhage and thrombosis.

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