REVIEW ARTICLE

CURRENT APPROACH TO THE MANAGEMENT OF URINARY STRESS INCONTINENCE

F K Lim, K Razvi, K F Tham, S S Ratnam

ABSTRACT

The plethora of treatment modalities available for the treatment of female urinary stress incontinence reflects the uncertainty in the pathophysiology of this condition and the mechanism of cure. No single treatment method is suitable for all patients. For best results, many factors must be considered before choosing the treatment method most suited to the particular patient. This review examines the various treatment options available and attempts to set out criteria for choice of treatment. The role of conservative treatment has been deliberately highlighted especially for young and well motivated women with mild to moderate urinary stress incontinence before surgical treatment is used. The role and limitations of well established surgical procedures like Burch colposuspension and urethroplasty and the more recently introduced procedures like collagen implants, laparoscopic colposuspension and the role of artificial urinary sphincter are also examined.

Keywords: *urinary incontinence, stress physiotherapy, urinary incontinence, stress surgery*

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INTRODUCTION

Urinary stress incontinence is the most common cause of urinary incontinence in the females, accounting for about 50-60% of cases[1]. Together with urge incontinence they make up 80-90% of cases of female urinary incontinence[1]. The success of treatment for urinary stress incontinence depends on accurate diagnosis as there are many other possible causes of urinary incontinence, each with differing method of treatment.

Urodynamics took off about two decades ago with the formation of what is now called the International Continence Society. Prior to the 1960s, concept of the causes of urinary incontinence had been dominated by anatomical considerations and for most gynaecologists, urinary incontinence in most women was incontinence associated with urogenital prolapse. The advent of pressure measuring devices allowed recognition that abnormalities of bladder function were almost as common a cause of incontinence as stress incontinence.

The widespread use of urodynamic investigations like cystometry, urethrometry, combined pressure/video studies, real time ultrasound imaging and neurophysiological studies has led to a better understanding of bladder dysfunction and disturbances in the function of the urethral sphincter mechanism and the pelvic floor. With the increasing awareness of the complexity in the aetiology of urinary incontinence, the approach is now much more systematic and rational compared to that two decades ago when anterior colporrhaphy was the standard treatment for urinary stress incontinence. Nevertheless, large areas of controversy concerning the mechanism of stress incontinence and the choice of treatment modalities still remain. The precise reason why some operations work remains unresolved. Even the theory of pressure transmission, which is the most widely accepted, has been challenged[2].

The emphasis on a detailed clinical assessment and the appropriate use of urodynamic investigations has contributed to better understanding and more accurate evaluation of urinary incontinence. This to a large extent helps in our choice of treatment. It is particularly important to rule out co-existing detrusor instability and voiding disorder as surgery for stress incontinence, especially the suprapubic procedures like colposuspension, may worsen the unstable bladder and voiding dysfunction[3,4]. In such cases, it is important to treat the detrusor instability before attempting stress incontinence surgery.

MECHANISM OF URINARY INCONTINENCE

The normal continence of urine during stress is thought to be achieved by three mechanisms: (a) intrinsic urethral tone contributed by muscular action of the urethra, vascular turgor, elasticity of the urethral connective tissue and the urothelium, (b) transmission of abdominal pressure onto the proximal part of the urethra and the urethrovesical junction (bladder neck), and (c) kinking of the urethrovesical junction at the time of stress which requires a well supported bladder neck. The second mechanism requires the bladder neck to be within the abdominal cavity and the absence of tissue rigidity around the proximal urethra so that pressure can be transmitted during stress.

Parturition causes damage to the neurological supply of the pelvic and urethral muscles[5] and physical damage to the pelvic fascia, support ligaments and muscles. These cause decrease in urethral tone as well as prolapse of bladder neck below the urogenital diaphragm and subsequent failure of pressure transmission. The bladder neck also becomes hypermobile, preventing the kinking mechanism at the time of stress. As the integrity of urogenital tissues are dependent on oestrogen, menopause compounds the problem by further weakening the tissue.

Department of Obstetrics & Gynaecology
National University of Singapore
National University Hospital
5 Lower Kent Ridge Road
Singapore 119074

F K Lim, MRCOG
Senior Lecturer and Consultant

K Razvi, MBBS
Resident

K F Tham, MRCOG
Senior Lecturer and Consultant

S S Ratnam, DSc (Hons)
Head of Department

Correspondence to: Dr F K Lim

THE PRINCIPLES OF STRESS INCONTINENCE TREATMENT

The main aims of treatment for stress incontinence are: (1) to restore the position of the bladder neck and proximal urethra within the abdominal cavity, (2) to increase the intrinsic urethral resistance, (3) to prevent funnelling of the bladder neck by strengthening the support tissue around the bladder neck, and (4) fixation of the bladder neck so that stress will cause kinking of the urethrovesical junction. Not all the objectives can be achieved by a single operation or procedure.

Choice of treatment

Baker Brown documented the first surgical approach to stress incontinence in 1864 when he advocated cystotomy as treatment for stress incontinence. Since then, over 150 types of surgical procedures have been devised for this problem[6]. The large number of different procedures reflects our uncertainty about the pathophysiology of this condition and the mechanism of cure.

The treatment objectives may be achieved by (a) conservative methods, or (b) surgical methods. It is extremely important to examine the vagina and bladder neck carefully before choosing the type of treatment. Stress incontinence must be objectively demonstrable in the supine or the erect position. A careful pelvic examination must be done to exclude any pelvic masses. Examination in the Sims' position is essential for complete assessment. The bladder neck must be examined for scarring, mobility and prolapse. Accurate and detailed documentation of any associated vaginal or uterine prolapse must be made so that pelvic floor repair procedures can be incorporated during reconstructive surgery. The pelvic tone, any pelvic deficiency and the ability to contract pelvic floor muscle have to be assessed, particularly if conservative treatment is contemplated.

The bladder has been described as an "unreliable witness" as there is considerable overlap between symptom complexes. The symptom of stress incontinence is not specific to genuine stress incontinence (urethral sphincter incompetence) but may occur with detrusor instability and overflow incontinence. Most urogynaecologists would consider urodynamic investigations mandatory before embarking on treatment, particularly surgical treatment, as presence of bladder dysfunction will compromise success.

If the bladder neck is hypermobile, abdominal elevation of the bladder neck like Burch colposuspension will most likely be successful. When the bladder neck is rigid, scarred and immobile, urethroplasty or colposuspension is unlikely to be successful because of poor elevation of the bladder neck and poor transmission of pressure to the bladder neck due to rigid scar tissue. This group of patients will require urethrolysis to free the bladder neck and a sling operation. More recently, collagen implant either transurethrally or paraurethrally has become available with promising short term results. However, longer term results are still uncertain.

Conservative treatment

The role of conservative treatment has been grossly underestimated. However, recently, an increasing attention has been paid to this modality of treatment. Although the cure rates for conservative methods are generally lower than that for surgical treatment, there are certain advantages. The success rate of conservative treatment is reasonable, it is free from complications, cheap and non invasive. The patient still has surgical options should conservative treatment fail. Conservative treatment can be carried out either singly or in combination. This includes (i) pelvic floor exercises, (ii) vaginal cones, (iii) electrical stimulation by interferential therapy, and (iv) medical treatment.

(i) Pelvic floor exercises (PFE)

With the regimen of 300 contractions a day, Kegel reported a cure rate of 80%[7]. More recently, some authors reported cure rates of 8%[8] to 27%[9]. However, about 60% of patients reported cure or significant improvement in symptoms with pelvic floor exercises[9-11]. The effect of pelvic floor exercises seems to have a good long term result. A long term study with a median follow-up of 6 years showed that at 12 months, 42% of patients were satisfied and the beneficial effect seemed to continue years after the initial formal pelvic floor exercise programme[12].

Tapp et al reported a randomised trial comparing PFE, PFE and faradism, or Burch colposuspension[8]. At 6 months assessment, 10% were cured and 33% in the group treated by PFE had improvement. In the group treated by PFE and faradism, 43% had cure or improvement. The result of colposuspension showed 96% cure or improvement. The addition of faradism to PFE did not seem to improve success rate for stress incontinence.

Several good prognostic factors have been identified for predicting the likelihood of benefit from pelvic floor exercises. Shorter duration of symptoms, less severe symptoms, better urethral function (maximal urethral pressure of greater than 9.4 cm of water and good functional urethral length), a motivated patient, youth and ability to contract pelvic floor muscles at initial assessment have been recognised as positive factors for successful treatment[8,13]. Chronic cough, uterovaginal prolapse and previous surgery were noted to be unfavourable factors for success with such therapy.

(ii) Vaginal cones

Weighted vaginal cones were introduced by Plevnik to improve levator muscle tone[14]. Cones of increasing weight from 20g to 100g are placed in the vagina and held in place by the levator ani muscles with the larger end uppermost. The patients are instructed to retain the cone for 15 minutes twice a day. If the cone can be retained successfully on two occasions, the cone with the next weight increment is used. Vaginal cones are thought to provide a feedback response due to feelings that the cone is slipping out, causing the pelvic floor to contract. An objective improvement rate of 68% was reported at 6 weeks in 34 women[15]. Peattie et al[16] and Kato et al [17] reported a cure and improvement rate of 70% after one month of treatment.

(iii)Electrical stimulation

Electrical stimulation by interferential therapy seems to have promising results. Seventy-three percent of patients showed objective improvement 6 months after interferential therapy[18]. This impressive result is supported by an earlier study[19].

(iv) Medical treatment

Menopause, with the associated oestrogen deficiency, may have a negative influence on urethral pressure profilometry by its effect on collagen and vascular turgor in the urethra. Several studies have shown beneficial effects of oestrogen therapy on urethral pressure and urethral closure pressure[20,21]. On the other hand, there are other studies which failed to show any significant effect of oestrogen on urethral pressure profile or stress incontinence[19,22]. The combination of oestrogen and the alpha adrenoceptor agonist, phenylpropanolamine, seems to have synergistic effect on the urethra. A controlled study by Kinn & Lindskog reported a cure rate of 28% and an improvement rate of 53%[23]. Hilton et al supported these findings in an objective trial[24]. The role of medical treatment in stress incontinence is perhaps limited, but it can be used as an adjunct with other conservative treatment or surgery.

Although conservative treatment is less effective compared to surgery, it can be recommended for young, motivated patients

with mild urinary incontinence, satisfactory pelvic tone, absence of significant uterovaginal prolapse, and the ability to contract the pelvic floor during initial assessment. Cost is minimal, and it is completely free of the complications of surgery. Surgical treatment can be resorted to as a second line measure.

Surgical treatment

Surgical treatment for stress incontinence may be approached (a) vaginally, (b) abdominally, or (c) by a combined approach. In general, cure rates for vaginal urethroplasty tend to be lower than those for suprapubic operations. However, there are some clinical situations where the vaginal approach has some advantages. Vaginal surgery is less likely to produce voiding difficulties and detrusor instability, which are well established complications of suprapubic operations. So, in those women in whom postoperative voiding difficulty is anticipated or when they have superimposed detrusor instability, vaginal urethroplasty might be the best treatment. In women who have associated uterovaginal prolapse, vaginal urethroplasty can be combined with pelvic floor repair and vaginal hysterectomy. In old and frail women, vaginal urethroplasty is better tolerated than an abdominal procedure. Other than this group of patients, most are suitable for some form of colposuspension.

(i) Anterior colporrhaphy/urethroplasty

The main aim of urethroplasty is to elevate the bladder neck by plicating the pubocervical fascia underneath the bladder neck. In this operation, it is very important to dissect and expose the bladder neck and pubocervical fascia as laterally as the subpubic arch, taking deep and generous bites of the pubocervical fascia using delayed absorbable suture like vicryl no.O. The majority of reports show cure rates of 30-70%[25-28]. There are some authors who reported very credible results with cure rates of 80-92%[29-31]. Reports showing good results emphasise the correct and deep placement of sutures into the pubocervical fascia at the bladder neck and proximal urethra. This achieves good elevation of the bladder neck and increase in intraurethral pressure[31]. An interesting observation with anterior colporrhaphy is that patients with detrusor instability associated with bladder neck funnelling were cured in 84% of cases after surgical correction[31]. Those without bladder neck funnelling, however, did not show similar improvements.

(ii) Burch colposuspension

This remains the golden standard for stress incontinence surgery with, consistently, the best short and long term cure rates. It has largely replaced the Marshall-Marchetti-Kranz (MMK) operation in most parts of the world because: (1) ileopectineal ligament is a more secure structure for the placement of suture in Burch colposuspension compared with the periosteum in the Marshall-Marchetti-Kranz operation, and (2) the complication of osteitis pubis associated with the Marshall-Marchetti-Kranz operation is avoided.

A Foley's catheter is introduced to help identify the bladder neck. Through the Pfannensteil incision, the retropubic space (Cave or Retzius) is developed and the paravaginal tissue on both sides of the proximal urethra and bladder neck are exposed. Three no. 1 non absorbable sutures are inserted into the paravaginal tissue on either side of the bladder neck and these are tied to the ileopectineal ligaments on the respective sides. It is very important not to elevate the paravaginal tissue excessively as this causes unphysiological kinking of the urethrovesical junction and subsequent bladder neck obstruction, which is thought to be associated with post operative difficulties as well as *de novo* detrusor instability. The aim is to take up the slack and provide a well supported shelf for the bladder neck. One does not have to approximate the paravaginal tissue to the ileopectineal ligaments and the bow string effect does not compromise the chances of cure.

Cure rates of 81-96% have been quoted[25,27,28,32]. In a long term follow-up study based on objective and urodynamic data, with an average follow-up period of 9.4 years after surgery, the cure rate was 97.3% at one year, decreasing to 91.7% after five years, and 90.3% at 8-12 years[33]. However, high incidence of voiding dysfunction have been reported for this operation: 25% suffered delayed voiding and 20% had increased residual urine with reduced flow rate 3 months after surgery[34]. This high incidence is perhaps due to overenthusiastic elevation of the bladder neck. Development of enterocoele is another well recognised long term complication of Burch colposuspension, occurring in about 10% of cases[32,35,36].

(iii)Sling operation

Since the first sling operation was described in 1907, there have been numerous modifications to this procedure[37]. Different materials have been used : (a) organic materials, including patient's own rectus fascia, fascia lata, porcine skin and bovine rectus sheath, and (b) inorganic materials such as nylon, mersilene, martex, teflon and silastic. The main indication for sling operation is complicated stress incontinence where there is history of failed incontinence surgery with a scarred bladder neck.

The most commonly performed sling procedure is the Aldridge sling operation. Two incisions are used : (1) midline anterior vaginal incision, and (2) low Pfannensteil incision. The bladder neck is exposed and adhesions are lysed as laterally as the symphysis pubis. Two strips of sling are fashioned from the rectus fascia with free lateral ends and attached medial ends. The cave of Retzius is developed and bladder neck displayed. The slings are then passed down alongside the bladder neck on both sides and the ends sutured across the inferior surface of the bladder neck making sure to avoid excessive tension as this may cause voiding difficulties due to outlet obstruction. A rule of thumb is to leave a slack of about 1 cm below the bladder neck to allow for fibrosis and the resulting shortening.

(iv)Needle suspension procedure

Pereyra described the first needle suspension procedure in 1959[38]. Various modifications have since been made with the more popular ones by Stamey[39] and Raz[40]. Currently, the Stamey operation is the most popular. These procedures are popular with urologists but less so with gynaecologists. The needle suspension procedure offers some advantages because it requires minimal dissection, needs shorter operating time and is particularly useful when there is limited access to the pelvis as in obesity, previous radiotherapy, previous surgery, and in elderly and frail women.

Basically, the aim is to suspend the paravaginal tissue at the level of the bladder neck from the rectus sheath by using long needle to carry the sutures between the two. Although often referred to as endoscopic suspension of the bladder neck, the cystoscope is used only to position the sutures and to avoid bladder trauma.

Cure rates have been inconsistent, ranging from 40-90%[41-45]. The average cure rate from 20 reports over the past 10 years was 73%[6]. Early cure rate for Raz procedure was encouraging at 94%[46] at 2 years follow-up. Longer term follow-up suggested cure rate of only 51%[47]. Another study suggested similar findings for modified Raz procedure; 94% cure rate at 3 months and 24% cure rate at long term follow-up with a mean follow-up of 27 months[48]. Hilton and Mayne, using the modified Stamey operation in an actuarial follow-up over 4 years, showed initial objective cure rate of 83% at 3 months, falling to a

subjective cure rate of 53% in patients under 65 years of age and 76% in those older at 4 years follow-up[44]. It therefore appears that needle suspension procedures have acceptable results in the short term. However, failure at long term follow-up makes it unsuitable as first line treatment especially in young women. The abdominal wall, being a less secure anchor compared to the ileopectineal ligament, may be the reason for the poorer long term result when compared with the Burch colposuspension.

(v) Laparoscopic retropubic colposuspension

Based on the good results obtained with Burch colposuspension, attempts have been made to achieve the same surgical objective with a minimally invasive approach using laparoscopic colposuspension. Preliminary results in 58 cases seem to be encouraging with a reported success rate of 95% with a follow-up period of 6-22 months[49]. The author also claimed that blood loss was minimal, with an average loss of less than 50 ml, and hospital stay was short (mean hospital stay of 1.22 days). This new technique has to be assessed in terms of long term success rate, surgical morbidity, cost, duration of surgery and reproducibility, before being adopted widely.

(vi) Collagen implantation at the bladder neck

Augmentation of urethral pressure by injection of implants at the bladder neck may be indicated for patients who have normally sited bladder neck where the stress incontinence is due to urethral sphincter weakness. Murless in 1938 reported injection of sodium morrhuate around the bladder neck but later abandoned the procedure because of embolisation of the material resulting in pulmonary infarction[50]. Use of Teflon paste as implant material have been reported with cure rates ranging from 21% to 75%[51-53]. Teflon injection is associated with many problems; difficulty in administering the injection, requiring high pressure and a large bore needle, and extrusion of the material at the injection site. Embolisation of the Teflon material to distant sites like the lungs, spleen, liver and brain has been reported[54].

An injectable collagen gel, extracted from bovine skin, was used to correct skin defects in plastic surgery with only temporary improvements, as resorption occurs in 3 months[55]. When the collagen fibrils are cross linked with glutaraldehyde, the host replaces the collagen implant with endogenous collagen[55]. This may result in a more permanent enhancement of the soft tissue.

In a series of 25 women with genuine stress incontinence, paraurethral injection of gluteraldehyde cross linked collagen resulted in 80% cure or improvement at 3 months follow-up[56]. An increase in urethral closure pressure with decrease in urine flow rate and increase in detrusor pressure was found post operatively. The success rate was found to be significantly higher (90%) in those patients who had previous incontinence surgery when compared to those who had no previous surgery (73%). The higher success rate in those with failed previous incontinence surgery may be due to a less mobile bladder neck as a result of scarring. A more recent prospective study of 50 women with type 3 genuine stress incontinence reported a success rate of 82%[57]. Longer term follow-up of these patients is necessary to ascertain long term cure rate and larger series are needed to assess efficacy before a firm recommendation can be made for its use as routine first line treatment. However, it holds great promise for those with failed previous incontinence surgery. The main drawback is perhaps the cost of collagen and the need for repeat injections in some cases.

(vii) Artificial urinary sphincter

For patients with recurrent urinary stress incontinence after previous failed surgery, cure rates from subsequent surgery are generally poor. Colposuspension may give reasonable success rates in these patients, if the bladder neck remains mobile or if the bladder neck and proximal urethra remains healthy after division of adhesions with successful mobilisation of the bladder neck. Duncan et al reported an 85%(39/46) subjective cure rate for these patients[58]. In those with fixed, well supported, badly scarred and fibrosed bladder neck and urethra, where the incontinence is due purely to severe sphincter weakness (Type III urinary stress incontinence), the result of subsequent surgery is generally very poor. In these desperate patients, some authors have advocated the use of artificial urinary sphincter.

The first model of artificial urinary sphincter, the AS-721 (developed by the American Medical Systems Inc.) was first implanted in 1972. Since then, there has been several improvements, with subsequent models being designated as AS-741, AS-742, AS-761, and AS-791. The current model, AS-800, was introduced in 1982. The reliability and effectiveness of the artificial urinary sphincter has improved steadily with each development. The AS-800 consists of three components; an inflatable cuff which is placed around the bladder neck, a pressure-regulating balloon which is implanted adjacent to the bladder extraperitoneally, and a pump which is placed in the labia majora immediately underneath the skin. The three components are interconnected by fluid filled tubes. A valve, a re-fill delay resistor and a deactivation button are all incorporated in the pump. The prosthesis can be deactivated by squeezing the deactivation button on its side thus allowing post operative recovery. Activation is achieved by a sharp squeeze on the pump. Subsequently, squeezing the pump will transfer fluid from the cuff into the balloon. The balloon begins automatic repressurisation immediately, but a resistor delays the refill of the cuff to allow time for micturition. When the cuff refills as a result of pressure provided by the balloon, the pressure around the urethra provides continence until it is time to urinate again[59].

The artificial urinary sphincter has been shown to be effective in the treatment of patients with type III stress incontinence. In a large series by Scott, 406 patients had artificial urinary sphincter insertion, of which, 41 cases were for women with history of failed stress incontinence surgery. He obtained good results in these women, with an early cure rate of 100% (41/41), but this decreased to 68% in the longer term[59]. Other reports have also been rather encouraging; Diokno et al[60] reported a cure rate of 91% (29/32) with an average follow-up of 2.5 years; Appell[61] reported success rate of 100% (34/34) and more recently, Webster et al[62] reported a cure rate of 92% (22/24) with a mean follow-up of 2.6 years.

The main problems with the artificial urinary sphincter are: (1) cuff erosion and infection, and (2) mechanical failure. In the report by Scott[59], 23.6% (96/406) of the artificial sphincter had to be removed because of cuff erosion and/or infection. Duncan et al[58] reported even higher removal rate of 31% (9/29) because of cuff erosion or infection. Webster et al[62], however, reported no sphincter erosion or infection in his 24 cases but 4 (17%) patients required revision over a seven to eight-year follow-up period because of device malfunction. In his study, the AS 800 model was used in 22 of the 24 patients. Similarly, Diokno et al[60] reported only one case requiring device removal because of pelvic abscess but mechanical failure requiring surgical revisions occurred in 7 of the 32 patients (21%).

For the small desperate group of patients with repeated failures from urinary incontinence surgery, artificial urinary sphincter seems to hold some promise of cure. However, in most studies, the follow-up period is not long enough for the assessment of long term cure rates. The report by Scott[59] seems to suggest a decreasing success rate with time. This is not surprising as with all mechanical devices, mechanical failure is to be expected. With improved surgical techniques and better

sphincter design, hopefully, failures can be minimised.

CONCLUSION

This review examines the various options available for the treatment of genuine stress incontinence with emphasis on detailed pretreatment assessment and accurate diagnosis. No single method of treatment is suitable for all patients. The choice of treatment will depend on various factors like severity of incontinence, degree of bladder neck prolapse, age and general health of the patient, previous attempts at surgical treatment, degree of bladder neck scarring and presence or absence of detrusor instability and voiding difficulties. Young and active women will benefit from Burch colposuspension as the results tend to be more permanent. Old and frail women may be best treated by anterior colporrhaphy especially when there is associated voiding difficulties and uterovaginal prolapse. The surgeon who treats genuine stress incontinence should be familiar with the various treatment modalities available.

References

1. Sutherst JR. Contintnce and incontinence. In: Sutherst JR, Frazer MI, Richmond DH, Haylen BH. eds. Introduction to clinical gynaecological urology. London: Butterworth-Heinemann 1990: 31-40.
2. Ulmsten U, Petros P. Surgery for female urinary incontinence. Curr Opin Obstet Gynae 1992; 4:456-62.
3. Stanton SL, Cardozo L. Results of colposuspension for incontinence and prolapse. Br J Obstet Gynaecol 1979; 86:693-7.
4. Cardozo L, Stanton SL, Williams J. Detrusor instability following surgery for genuine stress incontinence. Br J Urol 1979: 51:204-7.
5. Smith ARB, Hosker GL, Warrell DW. The role of pudendal nerve damage in the aetiology of genuine stress incontinence in women. Br J Obstet Gynaecol 1989; 96:29-32.
6. Hilton P. What operation for what patient? In: Drife JO, Hilton P, Stanton SL. eds. Micturition. London: Springer-Verlag 1990; 225-46.
7. Kegel AH. Progressive resistance exercise in the functional restoration of the perineal muscles. Am J Obstet Gynecol 1948; 56:238-48.
8. Tapp AJS, Hills B, Cardozo LD. Randomised study comparing pelvic floor exercise with Burch colposuspension. Neurouro Urodyn 1989; 8: 356-7.
9. Wilson PD, Faragher B, Butler B, Bulock D, Robinson EL, Brown AG. Treatment with piperazine oestrone sulphate for genuine stress incontinence in post menopausal women. Br J Obstet Gynaecol 1987; 94:568-74.
10. Hanella SM, Kirwan P, Castledon CM, Hutchins CJ, Bresson AJ. The effect of pelvic floor exercises in the treatment of genuine stress incontinence in women at two hospital. Br J Obstet Gynaecol 1988; 95:602-6.
11. McIntosh LJ, Frahm JD, Mallett VT, Richardson DA. Pelvic floor rehabilitation in the treatment of incontinence. J Reprod Med 1993; 38:662-6.
12. Klarskov P, Nielson KK, Kromann-Anderson B, Maegaard E. Long term results of pelvic floor training and surgery for female genuine stress incontinence. Int Urogynccol J 1991; 2:132-5.
13. Mantle J, Versi E. Physiotherapy for stress urinary incontinence: a national survey. Br Med J 1991; 302:753-5.
14. Plevnik S. New method for testing and strengthening of pelvic floor muscles. In: Proceedings of the International Continence Society. London. 1985: 267-8.
15. Wilson PD, Borland M. A preliminary study of vaginal cones for the treatment of genuine stress incontinencc. Proc Univ Otago Med Sch 1988; 66:37.
16. Peattie AB, Plevnik S, Stanton SL. Vaginal cones: A conservative method of treating genuine stress incontinence. Br J Obstet Gynaecol 1988; 95:1049-53.
17. Kato K, Kondo A, Hasegawa S, Saito M, Yamada Y, Murase T, et al. Pelvic floor muscle training as treatment of stress incontinence: the effectiveness of vaginal cones. Nippon Hinyokika Gakkai Zasshi 1992; 83:498-504.
18. Olah KS, Bridges N, Denning J, Farrar DJ. The conservative management of patients with symptoms of stress incontinence: A randomised prospective study comparing weighted vaginal cones and interferential therapy. Am J Obstet Gynecol 1990; 162:87-92.
19. Wilson PD, Sammari T, Deakin M, Kolbe E, Brown ADG. An objective assessment of physiotherapy for female genuine stress incontinence. Br J Obstet Gynaecol 1987; 94:575-82.
20. Rud T. The effect of oestrogens and gestogens on the urethral pressure profile in urinary incontinent and stress incontinent women. Acta Obstet Gynecol Scand 1980; 59:265-70.
21. Bhatia NN, Bergmen A, Karam MM. Effects of estrogen on urethral function in women with urinary incontinence. Am J Obstet Gynecol 1989; 141:176-81.
22. Samsioe G, Janssen I, Mellstrom D, Svandborg A. Occurrence, nature and treatment of urinary incontinence in a 70 year old female population. Maturitas 1985; 7:335-42.
23. Kinn AC, Lindskog M. Estrogens and phenylpropanolamine in combination for stress urinary incontinence in post menopausal women. Urology 1988; 32:273-80.
24. Hilton P, Tweddell AL, Mayne C. Oral and intevaginal estrogens alone and in combination with alpha adrenergic stimulation in genuine stress incontinence. Int Urogynecol J 1990; 1:80-6.
25. Stanton SL, Hilton P, Norton C, Cardozo LD. Clinical and urodynamic effects of anterior colporrhaphy and vaginal hysterectomy for prolapse with and without incontinence. Br J Obstet Gynaecol 1982; 89:459-63.
26. Weil A, Reyes H, Bischoff P. Modifications of the urethral rest and stress profile after different types of surgery for urinary stress incontinence. Br J Obstet Gynaecol 1984; 91:46-55.
27. Bergman A, Ballard DA, Koonings PP. Comparison of three different surgical procedures for genuine stress incontinence: Prospective randomised study. Am J Obstet Gynecol 1989; 160:1102-6.
28. Van Geelan JM, Theewes AGM, Eskes AB, Martin CB. The clinical and urodynamic effects of anterior vaginal repair and Burch colposuspension. Am J Obstet Gynecol 1988; 159:137-44.
29. Green TH. Urinary stress incontinence: differential diagnosis, pathophysiology and management. Am J Obstet Gynecol 1975; 122:368-400.
30. Warrel D. Anterior repair. In:Stanton SL, Tanagho EA. eds. Surgery for female incontinence. Berlin: Springer-Verlag. 1986: 77-86.
31. Beck RP, McCormick S, Nordstrom L. A 25-year experience with 519 anterior colporrhaphy procedures. Obstet Gynecol 1991; 78:1011-8.
32. Kiiholma P, Makinen J, Chancellor MB, Pitkanen, Hirvonen T. Modified Burch colposuspension for stress urinary incontinence in females. Surg Gynecol Obstet 1993; 176:111-5.
33. Herbertson G, Iosif CS. Surgical results and urodynamic studies 10 years after retropubic colpourethrocystopexy. Acta Obstct Gynecol Scand 1993; 72:298-301.
34. Lose G, Jorgensen L, Mortensen SO. Voiding difficulties after colposuspension. Obstet Gynecol 1987; 69:33-8.
35. Langer R, Ron-El R, Neuman M. The value of simultaneous hysterectomy during Burch colposuspension for urine stress incontinence. Obstet Gynecol 1988; 72:866-9.
36. Eriksen BC, Hagen B, Eik-Nes SH, Molne K, Mjolnerod OK, Romslo I. Long term effectiveness of the Burch colposuspension in female urinary stress incontinence. Acta Obstet Gynecol Scand 1990; 69:45-50.
37. Hohenfellner R, Petri E. Sling procedures. In: Stanton LS, Tanagho EA. eds. Surgery of female incontinence. Berlin: Springer-Verlag 1986:105-13.
38. Pereyra AJ. A simplified surgical procedure for the correction of stress incontinence in women. West J Surg 1959; 67:223-6.
39. Stamey TA. Endoscopic suspension of the vesical neck for urinary incontinence. Surg Gynecol Obstet 1973; 136:547-54.

40. Raz S. Modified Pereyra bladder neck suspension for female stress incontinence. Urology 1981; 17:82.
41. Peattie AB, Stanton SL. The Stamey operation for the correction of genuine stress incontinence in elderly women. Br J Obstet Gynaecol 1989; 96:983-6.
42. Stamey TA. Endoscopic suspension of the vesical neck for urinary incontinence in females: Report of 203 consecutive patients. Am Surg 1980; 192:465-71.
43. Mundy AR. A trial comparing the Stamey bladder neck suspension procedure with colposuspension for the treatment of stress incontinence. Br J Urol 1983; 55:687-90.
44. Hilton P, Mayne CJ. The Stamey endoscopic bladder neck suspension: a clinical and urodynamic investigations, including actuarial follow up over four years. Br J Obstet Gynaecol 1991; 98:1141-9.
45. Karram MK, Angel O, Koonings P, Tabor B, Bergmen A, Bhatia N. The modified Pereyra procedure: a clinical and urodynamic review. Br J Obstet Gynaecol 1992; 99:655-8.
46. Leach GE, Raz S. Modified Pereyra bladder neck suspension after failed antiincontinence surgery: surgical technique and results with long term follow up. Urology 1984; 23:359-62.
47. Leach GE, Kelly MJ, Roskamp DA, Knielsen K, Bruskewitz K. Long term follow up of the modified Pereyra bladder neck suspension. Proceedings of the 19th annual meeting of the International Continence Society. Ljubljana, Yugoslavia. Neurourol Urodynam 1989; 8:257.
48. Bosman G, Vierhont ME, Huikeshoven FJM. A modified Raz bladder neck suspension operation: results of a one to three years follow up investigation. Acta Obstet Gynecol Scand 1993; 72:47-9.
49. Liu CY. Laparoscopic retropubic colposuspension (Burch procedure): a review of 58 cases. J Reprod Med 1993; 38:526-30.
50. Murless BC. The injection treatment of stress incontinence. J Obstet Gynaecol Br Emp 1938; 45:67-73.
51. Politano VA, Small MP, Harper JM. Periurethral teflon injection for urinary incontinence. J Urol 1974; 111:180-3.
52. Lim KB, Ball AJ, Feneley RCL. Periurethral teflon injection: a simple treatment for urinary incontinence. Br J Urol 1983; 55:208-10.
53. Schulman CC, Simon J, Wespes E. Endoscopic injection of teflon to treat urinary incontinence in women. Br Med J 1984; 228:192.
54. Malizia AA, Reiman HM, Myers RP. Migration and granulomatous reaction after periurethral injection of Polytef (Teflon). JAMA 1984; 251:3277-81.
55. Kligman AM, Armstrong RC. Histologic response to intradermal Zyderm and Zyplast (Glutaraldehyde cross linked) collagen in humans. J Dermatol Surg Oncol 1986; 12:351-7.
56. Eckford SD, Abrams P. Para-urethral collagen implantation for female stress incontinence. Br J Urol 1991; 68:586-9.
57. Stricker P, Haylen B. Injectable collagen for type 3 female stress incontinence: the first 50 Australian patients. Med J Aust 1993; 18:89-91.
58. Duncan HJ, Nurse DE, Mundy AR. Role of artificial urinary sphincter in the treatment of stress incontinence in women. Br J Urol 1992; 69:141-3.
59. Scott FB. The artificial urinary sphincter: Experience in adults. Urol Clin North Am 1989; 16; 105-17.
60. Diokno AC, Hollander JB, Alderson TP. Artificial urinary sphincter for recurrent female urinary incontinence: indications and results. J Urol 1987; 138:778-80.
61. Appell RA. Techniques and results in the implantation of the artificial urinary sphincter in women with type III stress incontinence by a vaginal approach. Neurol Urodyn 1988; 7:613-6.
62. Webster GD, Perez LM, Khoury JM, Timmons SL. Management of type II stress incontinence using artificial sphincter. Urology 1992; 39:499-503.