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Operative Treatment of Genital Prolapse



ACADEMIC DISSERTATION

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ABSTRACT

Pelvic organ prolapse is a major health issue. Eleven per cent of women require surgical treatment for prolapse or urinary incontinence by the age of 80 years. Possible modes of operative treatment include vaginal or abdominal approach.

The aim here was to study outcomes of sacrospinous ligament fixation (SSLF) with pelvic floor reconstruction for vaginal vault prolapse and uterine procidentia, its tolerability in elderly women and the effect of concomitant vaginal hysterectomy on operative complications, and to compare outcomes of SSLF to those of abdominal sacral colpopexy (ASC). A further aim was to compare vaginal and transanal techniques for rectocele repair.

The study population consisted of 138 women who had undergone SSLF and 26 patients who had undergone ASC in Tampere University Hospital. Eighty-eight percent of patients who had undergone SSLF and 77 % of those who had undergone ASC were available for follow-up. At follow-up patients were assessed by interview and clinical examination. A total of 30 patients attended a prospective randomized study comparing the two techniques for rectocele repair. These patients were evaluated by interview, clinical examination, defecography, colon transit study and anorectal manometry.

At follow-up, 21 % of patients had suffered recurrence after SSLF, mostly cystocele, but only eight per cent had symptoms and five per cent were reoperated. The most significant factors predisposing to recurrence were postoperative pelvic infection, inexperienced surgeon, patient's low age and length of follow-up. Lack of intravenous antibiotic prophylaxis was the most significant risk factor for postoperative infection. Patients aged 80 years or more with no medical condition did well after surgery whereas women with a history of vascular disease had more often serious complications, including one death caused by pulmonary embolism. Concomitant vaginal hysterectomy did not affect the complication rate despite longer operative time. Recurrent apical prolapse was noted in three out of 26 patients (12 %) after ASC but in none out of 26 counterpart after SSLF. The overall recurrence rates were 12 vs 3, respectively. Posterior vaginal wall recurrences were noted in one (7 %) patient after vaginal and 10 (67 %) after transanal repair. No differences were noted between the groups in respect of symptom improvement.

SSLF with pelvic floor reconstruction is an effective means of treating massive genital prolapse. For good long-term outcomes avoidance of infections is essential. It is also a viable technique for elderly women, but those with vascular disease are at elevated risk of serious complications. If indicated, it can be performed concomitantly with vaginal hysterectomy without extra

complications. While both ASC and SSLF resulted in good apical support, ASC alone without pelvic floor repair made for more recurrences. Rectocele-related symptoms improved significantly by both vaginal and transanal techniques. However, the transanal technique resulted more frequently in recurrence than the vaginal approach.

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ABBREVIATIONS

ASC	abdominal sacral colpopexy
ICS	International Continence Society
IVS	intravaginal slingplasty
MARP	maximum anal resting pressure
MASP	maximum anal squeeze pressure
MRI	magnetic resonance imaging
POP	pelvic organ prolapse
POP-Q	pelvic organ prolapse quantification system
SSLF	vaginal sacrospinous ligament fixation
VH	vaginal hysterectomy

LIST OF ORIGINAL PUBLICATIONS

This thesis is based on the following original publications, which are referred to in the text by their Roman numerals. Some unpublished data are also presented.

- I Nieminen K, Huhtala H and Heinonen PK (2003): Anatomic and functional assessment and risk factors of recurrent prolapse after vaginal sacrospinous fixation. *Acta Obstet Gynecol Scand* 82:471-478.
- II Nieminen K and Heinonen PK (2001): Sacrospinous ligament fixation for massive genital prolapse in women aged over 80 years. *BJOG* 108:817-821.
- III Nieminen K and Heinonen PK (2000): Transvaginal sacrospinous ligament fixation with or without concurrent vaginal hysterectomy: A comparison of operative morbidity. *J Gynecol Surg* 16:101-106.
- IV Nieminen K and Heinonen PK (2000): Long-term outcome of abdominal sacral colpopexy or vaginal sacrospinous ligament fixation for posthysterectomy vaginal vault prolapse. *J Pelvic Surg* 6:254-260.
- V Nieminen K, Hiltunen K-M, Laitinen J, Oksala J and Heinonen PK. Transanal or vaginal approach to rectocele repair: A prospective randomized pilot study (submitted).

INTRODUCTION

Pelvic organ prolapse is a major health issue with an 11.1 % lifetime prospect of operative treatment for prolapse or urinary incontinence by the age of 80 years. With increasing life expectancy it is reasonable to estimate that in the future increasing numbers of women will seek treatment for pelvic organ prolapse (Olsen et al. 1997).

The aims of surgical treatment of genital prolapse are relief of symptoms, restoration of anatomy and maintenance of vaginal capacity for sexual function. Numerous surgical procedures have been proposed to correct genital prolapse employing either the abdominal or vaginal approach.

Sacrospinous ligament fixation (SSLF) is widely used in the treatment of both vaginal vault prolapse and uterine procidentia concomitantly with vaginal hysterectomy. As a vaginal operation it facilitates concomitant vaginal pelvic floor repair and can be performed under regional anesthesia. Concurrent treatment of enterocele is of fundamental importance. Sze and Karram (1997) noted in their review that the recurrence rates have mostly been lower than 20 %. Cystocele, either *de novo* or recurrent, has been the most frequent mode of recurrence, but surprisingly little is known regarding factors predisposing to recurrence. Transabdominal sacral colpopexy has been suggested to be the most effective method of treatment and also superior in preserving coital function.

In the 1970s and 1980s in many hospitals in Finland, the Manchester-Fothergill operation for uterovaginal and abdominal operations, e.g. sacral colpopexy or Williams-Richardson operation for vaginal vault prolapse were the most widely utilized operations. The rationale for adopting SSLF with pelvic floor reconstruction lay in the clinically disappointing results of Manchester-Fothergill operation. Secondly, a proportion of elderly patients were considered too frail for abdominal operations requiring laparotomy and general anesthesia.

Vaginal posterior colporrhaphy has been a standard gynecologic operation to repair a rectocele for over a century, with good anatomical results. Colorectal surgeons have advocated the transanal technique with similar results, but their focus has been more on improving bowel function. So far, studies comparing these approaches have been scant. The risk of dyspareunia has been a major concern after the vaginal approach (Kahn and Stanton 1997) but has surprisingly also been reported after transanal technique (Arnold et al. 1990).

The ideal technique for repair of genital prolapse should be effective, as assessed by long-term follow-up, with minimal complications and long-term adverse effects. The aim here was to assess operative complications and long-term results of vaginal sacrospinous ligament fixation, and risk factors associated

with recurrence, and to compare sacrospinous fixation with abdominal sacral colpopexy. A further aim was to compare outcomes of vaginal and transanal techniques for rectocele repair.

REVIEW OF THE LITERATURE

Historical background of pelvic organ prolapse and treatment

Early history

The first references to genital prolapse and proposals for treatment have been found in the Kahun papyrus of Egypt approximately 2000 years B.C. Hippocrates (400 B.C.) suggested wet feet, excessive exertion, fatigue and sexual excesses, especially in a recent parturient, as etiologic factors underlying uterine prolapse. He also attributed infertility to pelvic organ prolapse. Aetias, a few centuries A.D., suggested a fall, violent extraction of the placenta, a poorly executed delivery, prolonged labor in delivery, excessive heavy lifting and direct injury to the uterus as etiologic factors associated with the prolapse (Emge and Durfee 1966).

Hippocrates suggested succussion as a method to treat genital prolapse. The patient was tied to a ladder-like frame, which was moved upward and downward for 3-5 minutes. The force of gravity and shaking motion were thought to restore the prolapsing organs to their normal position. He was also the first to suggest vaginal supporting of the prolapse by a half pomegranate soaked in wine, which actually provoked vaginal constriction as well as constituting a mechanical barrier (Loret de Mola and Carpenter 1996).

Mechanical blocking of the vagina was the most widely accepted treatment for genital prolapse from the days of Hippocrates to the 1800s. Surgical procedure was accepted only when the uterus itself was gangrenous (Emge and Durfee 1966). Alsehavarius, in 1080, stated that if an organ was prolapsed and could not be reinserted it should be removed from below (Benrubi 1988).

Terminology and suggested etiologic factors

Benedetti was the first to use the word procidentia to describe complete uterovaginal prolapse in 1497 (Harris and Bent 1990). Van Roonhuyse of

Holland in the 1600s first described vaginal vault prolapse and suggested vaginal pessaries as treatment. He stated that the uterus was never part of genital prolapse. In the seventeenth century the Swiss Johan Peyer described cystocele and the possibility that both the uterus and the bladder could prolapse (Emge and Durfee 1966).

In the 1700s uterine prolapse was held to be a result of such factors as difficult and protracted labor and relaxation of both ligaments in the peritoneum. Manning introduced the theory that a rigid vagina was the most important factor in preventing uterine prolapse, and subsequently Hamilton suggested a rigid perineum to be the main support of pelvic organs (Emge and Durfee 1966).

In the early 1800s the terminology and classification of genital prolapse evolved into that in current use. They included uterine prolapse of various degrees, relaxation of the anterior wall or cystocele, relaxation of the posterior vaginal wall or rectocele, enterocele and procidentia or total uterovaginal prolapse and vaginal vault prolapse (Emge and Durfee 1966, Harris and Bent 1990).

In the nineteenth century many conservative methods were available for the treatment of genital prolapse, including different intravaginal pessaries. However, such treatments as cold water douches, hip baths and vaginal lavations and surf bathings were recommended, as well as uterine gymnastics and massage (Emge and Durfee 1966).

Development of surgery

Denudation of the vaginal mucosa was introduced in 1823 and was primarily used for uterine prolapse but subsequently also for cystocele. Toogood is credited with having performed the first vaginal hysterectomy for uterine prolapse in 1846, although there are reports of hysterectomies for prolapse from the 1600s and 1700s. The LeFort operation to totally obliterate the vagina, based on G. Simon's colpocleisis, was introduced in 1877 (Donald 1902, Emge and Durfee 1966, Benrubi 1988).

Brown attempted repair of rectocele with a horseshoe-shaped incision in the posterior wall of the vagina. In 1871 Emmet introduced the term pelvic fascia and his "posterior repair" which is apparently the basis of posterior colporrhaphy. Tait, in 1887, used a mucosal flap-splitting operation for rectocele, which was later used for the anterior vaginal wall as well. However, surgery for rectocele was often confused with perineal repair (Emge and Durfee 1966).

In 1888 Donald of Manchester introduced combined anterior and posterior vaginal wall repairs, perineorrhaphy and amputation of the cervix, which became the first widely used operation for genital prolapse (Loret de Mola and Carpenter 1996). He preferred (Donald 1902) plastic operations to hysterectomy and warned of the risk of vaginal vault prolapse after hysterectomy. This technique was further developed and reported by Fothergill (1915). He emphasized

anteversion of the uterus as an important factor in preventing recurrence and also stated that there is “no need to narrow the vagina”.

The first attempts to fixate the vagina emphasized fixing the uterus in a position of anteversion, because retroversion was regarded as the first stage of the prolapse. Sanger introduced a technique of suturing anteflexed uterus to the vagina, Wertheim and Vineburg shortened the round ligaments vaginally and Schauta introduced the term “interposition operation”, covering all the modifications (Donald 1902).

From the beginning of the 20th century developments in anesthetic methods and increased anatomic knowledge as well as the introduction of aseptic techniques reduced the mortality and morbidity of gynecologic surgery (Benrubi 1988). Mayo (1915) described his classical technique of vaginal hysterectomy for uterine prolapse and later Heaney (1934) reported on 565 vaginal hysterectomies by a technique, which has persisted to the present. He emphasized the low morbidity related to vaginal surgery. In addition to hysterectomy, both authors advocated concomitant pelvic floor repair.

Zweifel is acknowledged to be the first to surgically correct vaginal prolapse by a sacrotuberal technique in 1892 (Morley and DeLancey 1988). Miller (1927) reported a transvaginal method of fixating the vagina and sacrouterine ligaments to the anterior sacrum. Subsequently Amreich (1951) described extraperitoneal posterior gluteal and later, in the 1950s, vaginal route for fixating the vagina to the sacrotuberous ligament, which is a precursor of sacrospinous ligament fixation.

For correction of vaginal prolapse Ward (1938) recommended ox fascia to strengthen the round ligaments. Shaw (1948) introduced a technique with fascial support for posthysterectomy vaginal vault prolapse. Williams and Richardson (1952) introduced a transabdominal technique with ventral fixation of the vagina with transplantation of external oblique aponeurosis. Arthure and Savage (1957) described their hysteropexy and later Lane (1962) introduced a similar technique with interposing bridge between the vaginal vault and sacrum.

Treatment of pelvic organ prolapse in Finland

Literature dealing with history of POP and its treatment in Finland is scant. The interposition operations did not gain popularity in this country and vaginal hysterectomy was infrequently performed after the 1910s. Vaginal anterior and posterior colporrhaphies with modifications were the most often performed operations in the 1920s and the 1930s, whereas abdominal ventrofixation of the uterus was popular in the first two decades of the 1900s. Elevated mortality led to abandonment of abdominal ventrofixation despite the fact that results of combined abdominal and vaginal approach were superior (Listo 1934).

Waren (1934) recommended pelvic muscle exercises for women of fertile age with POP. He reported poor results with pessary treatment of postmenopausal patients and recommended minor surgery under local anesthesia. He suggested

Labhardt's "Kolpoperineokleisis subtotalis" for older women. The principle in this operation was to create a high perineum closing the vaginal orifice and preventing the prolapse from protruding. He admitted that the Labhardt's operation did not restore the anatomy, but stated that it sufficiently relieved the patient's physical and mental suffering.

The Manchester-Fothergill operation for uterovaginal prolapse has been popular in Finland during recent decades. For vaginal vault prolapse abdominal operations such as Williams-Richardson (Leminen et al. 1998) and abdominal sacral colpopexy (Kauppila et al. 1986b, Virtanen et al. 1994) have been the most popular techniques. SSLF gained popularity in the 1990s, but not in all institutes.

Terminology of pelvic organ prolapse

Prolapse (Latin *prolapsus*, a slipping forth) is a term referring to the falling or slipping out of place of a part or viscus. Pelvic organ prolapse (POP) is descent of the pelvic organs into the vagina, often accompanied by symptoms (Thakar and Stanton 2002). The term genital prolapse is used as a synonym for POP. Besides POP the term female pelvic floor dysfunction includes urinary and anal incontinence, sensory and emptying abnormalities of the lower urinary tract, defecatory and sexual dysfunction, and several chronic pain syndromes (Bump and Norton 1998).

Cystocele is a herniation of the bladder base into the vagina, which in cases of urethral hypermobility may be referred to as cystourethrocele (DeLancey 1993, Kobashi and Leach 2000). Female rectocele is herniation of the anterior wall of the rectum outside its normal confines, causing protrusion of the posterior vaginal wall and/or the perineum (Kahn and Stanton 1998). Enterocoele is a hernia of the peritoneal pouch of Douglas caudally between the vagina and rectum, usually containing small bowel or omentum (Raz et al. 1993). Uterine prolapse or descent is usually defined when the cervix protrudes outside the pelvis, generally concomitantly with cystocele and enterocoele without rectocele. According to Nichols (1992) this is named uterovaginal or sliding prolapse, the other form being general prolapse with cervix outside the introitus with cysto- and rectocele but no enterocoele. The term procidentia refers to total uterine prolapse with the uterine fundus outside the introitus (Shull 1993). Vaginal vault prolapse is a similar condition in patients who have undergone hysterectomy (Nichols 1992).

The International Continence Society (ICS) has published guidelines for the terminology pertaining to female pelvic organ prolapse, these having been updated quite recently (Bump et al. 1996, Abrams et al. 2002). According to these recommendations prolapse should be discussed in terms of vaginal wall segments rather than the organs lying behind it because the only structure visible to the examiner is the vaginal surface. Thus, anterior vaginal wall prolapse refers

to cystocele or anterior enterocele, prolapse of the apical segment to uterine or vault prolapse, and posterior vaginal wall prolapse to rectocele or enterocele.

Structural anatomy associated with surgery for vaginal vault prolapse, uterine procidentia and rectocele

Each anatomic structure for the support of the pelvic floor provides a functional contribution (Strohbehn 1998). The pelvic floor anatomy can artificially be divided into passive and active structures. Passive structures include bony pelvis and connective tissues and active support structures muscles and nerves. All the pelvic soft tissues are anchored to the bony pelvis (Nichols 1991b, Strohbehn 1998).

The connective tissue supports include organized aggregations of dense collagen called ligaments or tendons, and a less well defined aggregation of collagen, smooth muscle, elastin and fibrovascular bundles known as endopelvic fascia (Strohbehn 1998). These connective tissue strands attach the bladder, uterus, vagina and rectum to the pelvic walls. The endopelvic fascia constitutes a continuous unit, but distinct regions have been given individual names. The structures, which attach the uterus to the pelvic wall (broad, cardinal and sacrouterine ligaments), are known as the parametria. (Fig 1). Similar tissues attaching the vagina to the pelvic wall are referred to as the paracolpium, although they are continuous with the cardinal and uterosacral ligaments when the uterus has not been removed (DeLancey 1993).

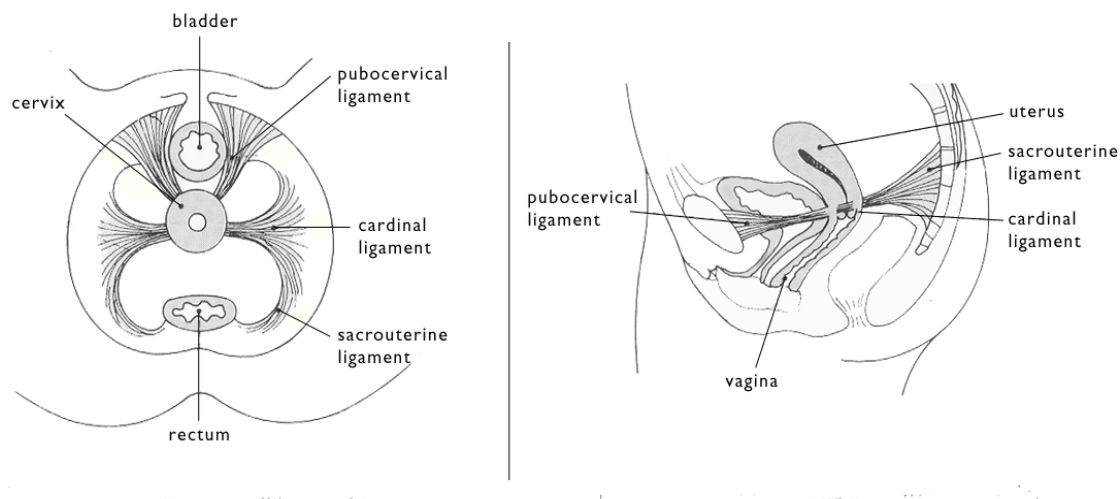


Figure 1. *The ligaments attaching the uterus and the vagina to the pelvic walls.*
(Adapted from Langman and Wordeman 1978)

Weber and Walters (1997) have recommended abandoning the term fascia because what is referred to is rather subperitoneal and perivascular connective tissue and loose areolar tissue than real fascia. They recommend the term adventitia with its location specified; for example vesicovaginal adventitia for the tissue between the urinary bladder and the vagina. Papers dealing with this matter advocate a diversity of views. Despite the controversy regarding the term fascia in this context, it is nonetheless widely used (DeLancey 1992a, b, Kahn and Stanton 1998, Strohbehn 1998).

The pelvic floor consists of muscles, which close the pelvic outlet pierced by the rectum, vagina and urethra through the genital hiatus. The pelvic diaphragm is composed of the levator ani and coccygeus muscles. Between the coccyx and the anus the levator muscles fuse to form a firm, muscular plate called the levator plate (Harris and Bent 1990, Strohbehn 1998). The tonic contraction of the puborectalis muscle, part of the levator-ani-complex, closes the urogenital hiatus and contributes to the horizontal axis of the proximal vagina and levator plate (Strohbehn 1998).

The pudendal nerve, which is derived from ventral roots of the 2nd, 3rd and 4th sacral nerve roots and its perineal branch, innervates the pelvic floor muscles. The active support of the pelvic floor relies on normal innervation, function and support of the levator ani musculature (Strohbehn 1998).

The arterial blood supply of the female pelvic organs comes from the branches of the internal iliac artery. The main vessel is the uterine artery providing blood to the uterus. The cervicovaginal artery, derived from the uterine artery immediately after crossing the ureter, supplies the posterior and anterior walls of the cervix and the vagina. The internal pudendal artery supplies the perineum (Langman and Woerdeman 1978).

Uterine and vaginal apex support

The upper third of the vagina and the uterus are held in place by various anatomic systems. The round and the broad ligament are the topmost supports of the uterus with limited clinical importance (Nichols 1991b).

The so-called cardinal ligament runs horizontally from bony pelvis to uterine cervix and upper vagina, containing the blood supply from the pelvis (Amreich 1951, Nichols 1991b). The uterosacral ligaments reach from the sacrum to the cervix and help to maintain the posterior location of the cervix. The cardinal ligaments support cervix and upper vagina laterally and posteriorly (Harris and Bent 1990, DeLancey 1992b).

DeLancey (1992a), in his famous work on cadaver dissection, divided the vagina into three levels. Level I constitutes the proximal two to three cm of the vagina. The level I support is called suspension, with primarily vertically orientated fibers of the paracolpium. In standing position some of the fibers proceed dorsally toward the sacrum in a more horizontal direction. Petros

(2001a) has confirmed these findings in his radiological study of 50 nulliparous females.

In the normal, woman upright at rest, the proximal vaginal axis is nearly horizontal, lying on the parallel levator plate. Colpographic studies have shown that as intra-abdominal pressure increases, the pelvic diaphragm contracts and maintains the position of the levator plate and horizontal vaginal axis (Nichols et al. 1970, Harris and Bent 1990, Nichols 1992, Raz et al. 1993). As a consequence, the uterus, the vagina and the rectum are pushed against the levator plate, not through the genital hiatus.

Posterior vaginal wall support

Both connective tissue and striated muscles maintain the support of the posterior vaginal wall (DeLancey 1999). The rectovaginal fascia, also referred to as Denonvillier's fascia, rectogenital septum, rectovaginal septum, perirectal fascia and vaginal fascia, consists of collagen, smooth muscle and elastin fibers (DeLancey 1992a, b and 1999, Richardson 1993, Kahn and Stanton 1998, Segal and Karram 2002). It is located immediately beneath the vaginal mucosa, merges superiorly with the cardinal and sacrouterine ligament complex, fuses laterally with the fascia over the levator ani muscle and merges distally into the perineal body (Richardson 1993).

Contraction of the levator ani muscles closes the vagina and relieves the connective tissue of constant load. With normally functioning levator ani muscles, no stress occurs on the midvagina support (DeLancey 1999).

In DeLancey's (1992a) terms the midvagina is called level II and the support is characterized as attachment. Level III or perineal body constitutes the distal two to three cm above the hymenal ring. Posteriorly the vagina fuses with the perineal body and the level III support is called fusion.

Sacrospinous ligament

The sacrospinous ligament with the sacrotuberous ligament strongly resists the anterior rotation of the sacrum into the pelvic cavity caused by the weight of the body (Langman and Woerdeman 1978). It courses from the ischial spine to the lateral aspect of the sacrum and fuses medially with the sacrotuberous ligament (Fig 2). The sacrospinous ligament lies on the dorsal aspect of the coccygeus muscle and is separated from the rectovaginal space by the rectal pillar (DeLancey 1992b). It is palpable inside the coccygeus muscle but not visualized (Kettel and Hebertson 1989).

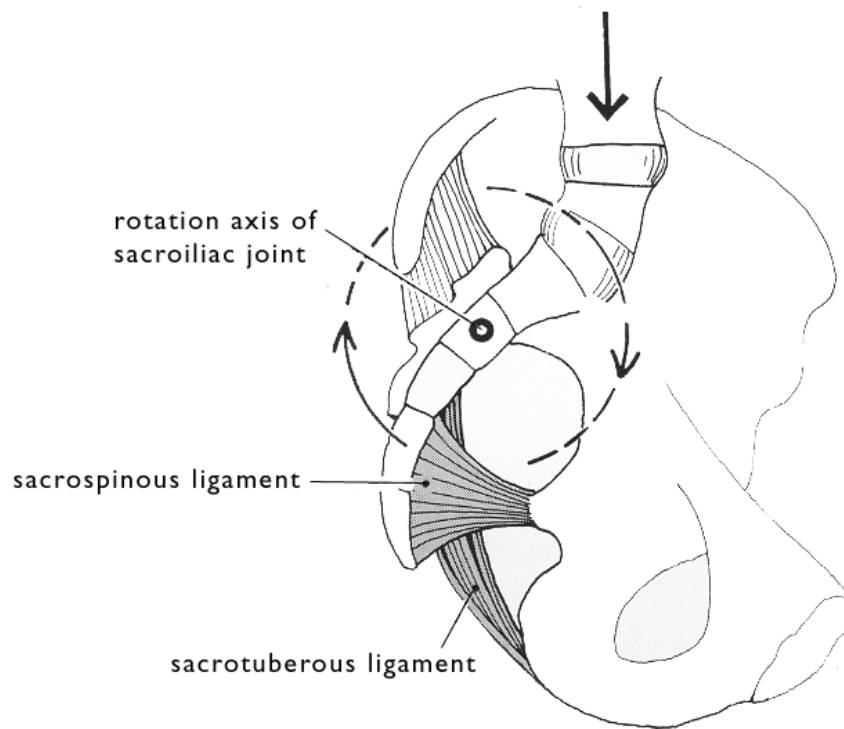


Figure 2. *The sacrospinous ligament runs from the ischial spine to the sacrum preventing, with the sacrotuberous ligament, anterior tilting of the sacrum into the pelvic cavity (Adapted from Langman and Wordeman 1978).*

The sacral plexus lies immediately adjacent to the ligament superiorly. The sciatic nerve and pudendal artery lie behind the ischial spine (DeLancey 1992b, Nichols 1992). In cadaveric dissections, the pudendal vessels and nerve pass medial and inferior within 0.5 cm from the spine and behind the ligament underneath the lateral third of the ligament (Verdeja et al. 1995, Thompson et al. 1999). The inferior gluteal artery passes posterior to the upper edge of the sacrospinous ligament, being the most commonly injured vessel (Barksdale et al. 1998, Thompson et al. 1999). The safest zone is located 2.5 cm medially from the ischial spine along the ligament, but not behind it (Kettel and Hebertson 1989, Thompson et al. 1999).

Etiology and pathophysiology of pelvic organ prolapse

Etiology

The etiology of the various types of pelvic organ prolapse is widely thought to be similar. The range of etiologic factors includes congenital weakness of tissues, parity, ageing and life-style, the most significant being advancing age and parity (Nichols 1992, Mant et al. 1997, Olsen et al. 1997, Samuelsson et al. 1999, Swift 2000). Ageing may constitute a factor in at least two ways: decreased estrogen levels and natural biologic exhaustion of tissues (Nichols 1992). The role of ethnic factors and race (Bump and Norton 1998, Swift et al. 2001, Hendrix et al. 2002, Sze et al. 2002) and previous pelvic surgery (Mant et al. 1997, Samuelsson et al. 1999, Swift et al. 2001, Hendrix et al. 2002) have been matters of controversy.

Labor and vaginal delivery are significant initiating factors in the development of POP. They can contribute to POP by damage to pelvic connective tissues, muscles and nerves of the pelvic floor (Smith et al. 1989, Gill and Hurt 1998). Neuromuscular damage seems to be the most important factor (DeLancey 1993). Pelvic neuropathies have been associated with childbirth in numerous studies (Gill and Hurt 1998). Nerve damage may result from direct compression as well as stretching of the nerves. Although many women evince evidence of pudendal nerve damage immediately after delivery, most recover by the end of the second postpartum month. However, pregnancy itself seems to be a risk factor for prolapse regardless of mode of delivery (O'Boyle et al. 2002, Sze et al. 2002).

Any condition leading to raised intra-abdominal pressure renders an individual liable to an elevated risk of pelvic organ prolapse. Pertinent factors include heavy work, chronic obstructive pulmonary diseases or coughing and obesity (Nichols 1992, Mant et al. 1997). Congenital factors such as defects of tissue strength or muscular innervation may be more common than previously thought (Nichols 1992, Norton et al. 1995) and increasing evidence suggests that women with POP have collagen deficiency (Gill and Hurt 1998). This hypothesis is supported by findings that women with first-degree relatives suffering urogenital prolapse carry an elevated risk of POP (Chiaffarino et al. 1999, Rinne and Kirkinen 1999).

Rectocele shares etiologic factors similar to those underlying other forms of POP. Additionally, all factors leading to higher pressure gradient towards the posterior vaginal wall may contribute to rectocele formation. Such factors include excessive straining due to constipation or nonrelaxing puborectalis syndrome (Kahn and Stanton 1998, Lukacz and Luber 2002, Segal and Karram 2002). Previous colposuspension (Wiskind et al. 1992, Kjølhede et al. 1997) and

prolapse surgery (Virtanen and Mäkinen 1993) predispose to rectocele formation mainly by reason of an altered vaginal axis (Kahn and Stanton 1998).

Pathophysiology

Most women with pelvic organ prolapse evince evidence of damage to the pelvic diaphragm (Gill and Hurt 1998). The primary event is the levator plate's loss of its horizontal position and movement to oblique or vertical position creating a funnel in the pelvic floor (Harris and Bent 1990, Nichols 1992, Wall 1993). The greater the tipping of the levator plate, the larger is the hiatus through which the pelvic organs can herniate. The injury to the levator plate is neurologic rather than disruption of the entire muscle (DeLancey 1993). Furthermore, DeLancey and Hurd (1998) have shown that the size of the urogenital hiatus correlates with the presence and also the grade of pelvic organ prolapse.

In pelvic organ prolapse, the pelvic connective tissue fails to hold the organs in place. Damage to pelvic connective tissue by rupture is common (Richardson et al. 1976). However, constant loads on connective tissues of pelvis obviously cause the same type of elongation as that associated with stretching of any ligament or tendon (DeLancey 1993).

Norton (1993) has clarified the development of prolapse with the "boat in dry dock" analogy. The pelvic organs (the boat) are supported by water (pelvic musculature) and held in place by its moorings (pelvic ligaments and fascia). If the water is removed, the moorings are suddenly placed under great strain. If the moorings are stretched or cut, any changes in the level of water will become immediately evident.

According to DeLancey's classification (1992a) the type of prolapse depends on the level of connective tissue damage. If level I fibers are damaged it will lead to an apical defect, whereas posterior level II damage would lead to rectocele. Petros (2001a) has stated the point that the vagina has no inherent strength or definable shape, its shape and tension are created by slow-twitch muscle contraction against its suspensory ligaments.

Epidemiology

Genital prolapse is a major reason for gynecologic surgery. Olsen and associates (1997) analyzed data on 149 554 women in the USA and found an 11.1 % lifetime risk of undergoing an operation for pelvic organ prolapse or urinary incontinence. In this survey, 29.2 % of the operations were repeat procedures. In a British study, again, 17 032 women aged between 25 and 39 had an average follow-up of 17 years. The incidence of hospital admission with prolapse was 2.04 per 1000 person-years (Mant et al. 1997).

In recent studies the prevalence of genital prolapse has varied from 31 to 46 % (Samuelsson et al. 1999, Hendrix et al. 2002, Scherf et al. 2002). However, in a Swedish study only 2 % of women had prolapse reaching the introitus and only a small minority reported symptoms (Samuelsson et al. 1999). Furthermore, in a West African population 14 % of the women studied were estimated to warrant surgical intervention, but only 13 % of women with moderate or severe prolapse reported symptoms (Scherf et al. 2002). Age is an important factor and Luber et al. (2001) estimated that mature age groups need consultations for pelvic floor disorders 10 times the number as do their younger counterparts.

There are no published data on remission, but clinically pelvic organ prolapse does not seem to regress. Some women progress rapidly from mild to advanced stages, whereas others seem to remain stable for many years (Bump and Norton 1998).

The incidence of posthysterectomy vaginal vault prolapse in the literature varies from 0.2 to 43 % (Toozs-Hobson et al. 1998). Such estimates are usually based on proportion of the patients seeking treatment at the same institute as the primary operation. Marchionni and associates (1999) used the same modalities as previously in the literature and found a 0.4 % incidence of vault prolapse. However, when they systematically examined a cohort of 448 patients who had undergone hysterectomy, the incidence was 4.4 %.

The incidence of vault prolapse is higher when the indication for the hysterectomy was prolapse. Marchionni's group (1999) reported a 1.8 % incidence of vault prolapse with previous hysterectomy without prolapse and 11.6 % when hysterectomy was performed for genital prolapse.

Vault prolapse occurs more frequently after vaginal than abdominal hysterectomy (Symmonds and Sheldon 1965). This merely reflects the fact that vaginal hysterectomy often is performed for prolapse when the abdominal is not, rather than indicating any superiority of the abdominal approach (Marchionni et al. 1999).

Recent studies have shown a 14-16 % prevalence of uterine prolapse and 18-20 % of rectocele (Samuelsson et al. 1999, Hendrix et al. 2002, Scherf et al. 2002). Data on the prevalence of uterine procidentia or total uterine prolapse are lacking. The results of epidemiological studies on pelvic organ prolapse are difficult to compare, because definitions of prolapse vary and usually the majority of the patients is asymptomatic.

Assessment of patients with pelvic organ prolapse

Symptoms

Estimates suggest that 50 % of parous women have some degree of genital prolapse while only 10-20 % of them have symptoms related to prolapse. Such symptoms are related to the protruding tissue and dysfunction of associated organ systems (Theofrastous and Swift 1998).

Symptoms related to pelvic organ prolapse can arbitrarily be divided into areas of urinary disorders, fecal disorders, sexual dysfunction and pelvic discomfort, although symptoms of all types often coexist in the same individual.

Urinary disorders

Urinary incontinence is a common symptom of pelvic floor dysfunction, but not necessarily of pelvic organ prolapse. In an epidemiological study (Hendrix et al. 2002) incontinence and cystocele also had a strong association regarding the severity of cystocele. Patients with severe prolapse often recall that worsening of the prolapse improved stress incontinence, and vice versa, reduction of prolapse can produce stress incontinence (Wall and Hewitt 1994, Theofrastous and Swift 1998). Urinary incontinence and prolapse seem to share a common etiology, predisposing factors rather than prolapse being the reason for incontinence.

Many patients with advanced genital prolapse have urge incontinence, but the mechanism involved here is unknown. Wall and Hewitt (1994) suggested that urge-related symptoms in patients with vaginal vault prolapse are more likely due to anatomic distortion of the lower urinary tract than detrusor instability. Surgical correction of POP alleviates urge incontinence in many patients (Theofrastous and Swift 1998).

Urinary retention resulting from kinking and obstruction of the urethra is a common complaint of women with genital prolapse. Several studies have shown that abnormal voiding patterns such as diminished peak flow rates and elevated postvoid residuals are corrected by repair of the prolapse (Wall and Hewitt 1994, Theofrastous and Swift 1998). However, the degree of voiding dysfunction does not necessarily relate to the severity of prolapse (Theofrastous and Swift 1998). Incomplete voiding may predispose to urinary tract infection and even to ureteral reflux and renal damage (Beverly et al. 1997, Theofrastous and Swift 1998). The prevalence of hydronephrosis increases with increasing severity of prolapse (Beverly et al. 1997). Patients with vault prolapse seem to be less prone to hydronephrosis than those with uterine prolapse, because total uterine procidentia may produce more kinking in the ureters (Beverly et al. 1997).

Other urinary symptoms related to pelvic organ prolapse include frequency, urgency, nocturia and difficulty in initiating micturition. Factors other than urethral kinking and obstruction contributing to these symptoms include urethral funneling, low urethral pressure or bladder overdistention (Grody 1993).

Fecal disorders

Difficult emptying of the rectum (outlet obstruction), tenesmus, rectal splinting and digitation are symptoms related to genital prolapse, mainly a large rectocele. Outlet obstruction occurs when feces become trapped in the rectocele. However, Weber and associates (1998) investigated 143 women with POP and found no association between severity of prolapse and bowel dysfunction and suggested that these two conditions co-exist without causal relationship. Constipation caused by mechanisms other than outlet obstruction, for example slow colonic transit, is not usually related to genital prolapse (Sarles et al. 1989, Brubaker 1996).

Fecal incontinence is a relatively rarely described symptom, most likely because it is underreported by patients and underscrutinized by physicians. The prevalence of fecal incontinence in patients with pelvic organ prolapse or urinary incontinence is estimated to be around 20 % (Jackson et al. 1997, Meschia et al. 2002) as against two to three percent in the general population (Theofrastous and Swift 1998). Because the anal sphincter and pelvic floor musculature are innervated by branches of the pudendal nerve, it is not surprising that evidence of pelvic floor denervation and POP are associated with fecal incontinence.

Sexual dysfunction

Problems of sexual function such as dyspareunia, loss of sensation, lack of satisfaction or orgasm, vaginal dryness and impaired coitus are frequently reported to occur in women with POP (Timmons et al. 1992, Nichols 1992, Brubaker 1996, Jackson and Smith 1997, Kahn and Stanton 1998, Thakar and Stanton 2002). Abnormal anatomy and psychological and emotional factors, including low self-esteem, are suggested to be reasons for this dysfunction (Haase and Skibstead 1988, Field and Hilton 1993). However, many studies have failed to consider potential confounding factors such as age (Weber et al. 1995a, b). The prevalence of POP increases with age while sexual activity declines (Diokno et al. 1990).

Weber and associates (1995a) studied women scheduled for operative treatment for POP or urinary incontinence and compared them to healthy controls. They found no difference between the groups in measures of sexual function. In contrast, age was the most important predictor of sexual function. Rogers and colleagues (2001) using a condition-specific validated questionnaire, reported that women with POP or urinary incontinence were less frequently

sexually active but satisfaction with their sexual relationships was similar to controls. Barber and associates (2002) reported that POP was more likely than urinary incontinence to result in sexual inactivity.

Pelvic discomfort

Falling down sensation, pelvic pressure and heaviness, back or pelvic pain, awareness of a bulging mass and pain in the vagina and perineum are symptoms classically related to advanced degrees of POP (Nichols 1992, Theofrastous and Swift 1998, Tooze-Hobson et al. 1998, Thakar and Stanton 2002). Ulcerations may cause discomfort and bleeding. According to Nichols (1992), enterocele and vault prolapse are associated with pelvic heaviness and pressure and a bearing-down sensation caused by stretching of the mesenterium in the enterocele sac. Back pain is caused by the downward traction of the uterosacral ligaments. However, Theofrastous and Swift (1998) estimated that only one half of patients with advanced prolapse complain of pelvic discomfort.

Studies dealing with this matter are few in number. Heit and colleagues (2002) studied 152 patients with POP of various degrees and found no association of POP severity with pelvic or back pain and stated that there is no causal relationship between these two conditions.

Clinical examination

The goal of examination is to establish whether it is POP which causes a patient's symptoms and to suggest treatment options (Theofrastous and Swift 1998). Nichols (1992) recommended examining the patient during rest and under strain (the Valsalva maneuver) both supine and standing to facilitate diagnosis of enterocele. Theofrastous and Swift (1998) were in favor of a semi-upright position to provide an accurate reflection of in vivo pelvic support. Swift and Herring (1998) examined 51 women in both dorsal lithotomy and standing positions during maximal Valsalva and found no difference between the measurements. They concluded that the standing position is necessary only when symptoms do not correspond to physical findings. A mirror given to the patient may be helpful to confirm that the maximum prolapse is being observed (Shull 1993, Theofrastous and Swift 1998).

The necessary instruments to perform the examination are a speculum and a measuring device; usually a bivalve Sim's speculum is recommended (Jackson and Smith 1997, Theofrastous and Swift 1998). Anterior, posterior, superior and external introital surfaces must be examined systematically. The hymenal ring is the reference point. First the descent is estimated during maximal straining without speculum to note descent to or beyond the hymen and thereafter with the

speculum. Bimanual palpation is performed to exclude a pelvic mass. Rectovaginal palpation should be performed to note any rectocele/posterior vaginal prolapse or perineal defect and to identify the location of the defect in the rectovaginal septum (Nichols 1992). Enterocele can be distinguished from rectocele by the palpation of a sac protruding between the rectum and vagina. Other techniques are a bivalve speculum, transillumination of the rectovaginal space or observation of peristalsis in the posterior vaginal wall (Holley 1994).

Over a number of decades several classification systems to codify POP have been developed (Theofrastous and Swift 1998). The pelvic organ prolapse quantification (POP-Q) system introduced by Bump and colleagues (1996) is nowadays the only one which is widely accepted. It has also been objectively studied and proved to have good intra- and interexaminer reliability (Swift 2002). Three points anteriorly and posteriorly are measured in centimetres (cm) during maximal straining, two points externally and the vaginal length under no strain. The anterior and posterior points may have positive or negative values, the negative values indicating proximal to the hymen. The size of genital hiatus is measured from external urethral orifice to hymen at six o'clock and the perineal body from the centre of anus to hymen. The anterior and posterior points form the basis of the staging. The staging system can have values from 0 to 4, 0 meaning excellent support of all compartments and 4 total uterine procidentia or vaginal vault prolapse (Fig 3). The POP-Q system is a tool to quantify and stage results of physical examination at anterior, apical or posterior sites in the vagina, but it does not assign the specific location of fascial defects.

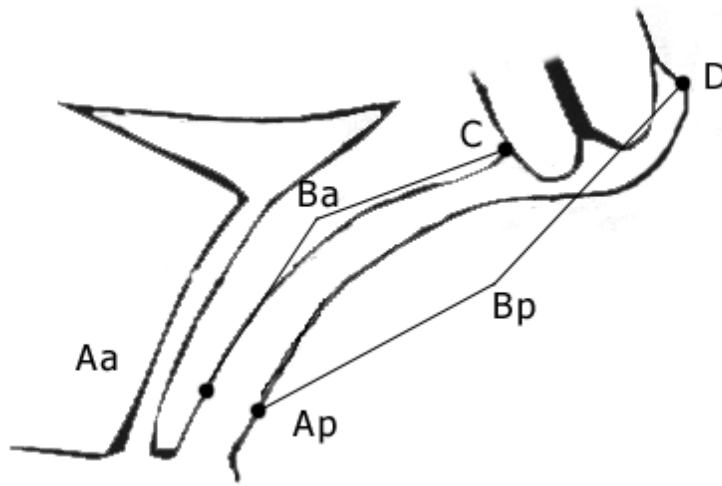


Figure 3. *Schematic illustration showing the six points in the vaginal wall which form the basis of the POP-Q system to quantify pelvic organ prolapse. In the presence of no prolapse, points Aa and Ap are three cm proximal from the hymen (-3), point Ba is the most distal point in the anterior vaginal wall between points Aa and C and point Bp the most distal point in the posterior vaginal wall between Ap and D. (Adapted and modified from Bump et al. 1996).*

Pelvic floor imaging

POP is diagnosed clinically and some gynecological textbooks do not even mention other investigations (Nichols 1992, Jackson and Smith 1997). On the other hand, urodynamic evaluation is frequently recommended when planning surgical treatment, although the clinical advantage of this has not been proved in a prospective study (Harris and Bent 1990, Kahn and Stanton 1998, Tooze-Hobson et al. 1998, Thakar and Stanton 2002). Imaging studies are recommended for cases when the symptoms and signs of POP do not correlate or there are difficulties with differential diagnostics or when prior surgery has failed (Weidner and Low 1998, Thakar and Stanton 2002, Fielding 2003). However, many articles dealing with rectocele recommend defecography when surgical treatment is chosen (Sarles et al. 1989, Arnold et al. 1990, Mellgren et al. 1995, Brubaker 1996, Karlbom et al. 1996).

Defecography or barium evacuation proctography gives information on the presence of rectocele, and its size, and the completeness of rectal emptying, intussusception and perineal descent (Kahn and Stanton 1998). The rectum is filled with barium paste and evacuation is monitored (Weidner and Low 1998, Kahn and Stanton 1998). Opacification of the small bowel with oral barium allows enterocele diagnosis. Barium may also be used in the urinary bladder or vagina to opacify these structures (cystoproctography) (Stoker et al. 2001). Defecography can also be performed with magnetic resonance imaging (MRI) but the results of this technique compared to radiographic are controversial (Delemarre et al. 1994, Schoenenberger et al. 1998). Slow colonic transit can be diagnosed by prolonged retention of radioopaque or scintigraphic markers (Kahn and Stanton 1998).

MRI is a radiological technique with superior soft-tissue differentiation. No contrast medium or preparation is required and ionizing radiation is also avoided (Weidner and Low 1998). It is more time-consuming and expensive than other imaging modalities and the examination is performed in the supine or left lateral decubitus position, but techniques with patients in upright position are developing (Weidner and Low 1998, Fielding 2003). Normal structures such as pelvic fasciae, pelvic floor muscles and organs can be clearly visualized as well as pelvic pathology, including scars and tears of soft tissue (Schoenenberger et al. 1998, Weidner and Low 1998, Fielding 2003). The importance of MRI in clinical work remains to be seen, but it is an important tool in the scientific study of the pelvic floor (Strohbehn et al. 1996).

Ultrasound examination, by transabdominal, endorectal, endovaginal, translabial or perineal approaches, is an eminently suitable diagnostic tool for some forms of pelvic floor dysfunction e.g. bladder neck hypermobility, postvoidal urinary retention or anal sphincter tears. At the moment, its role in clinical work is limited (Weidner and Low 1998, Stoker et al. 2001). However, it

may be suitable for objective assessment after surgical intervention (Dietz et al. 2001).

Anorectal manometry

Anorectal manometry is a method whereby anorectal function can be assessed and may be of assistance in diagnosing functional components which are faulty in anal incontinence or constipation (Kahn and Stanton 1998). With anal pressure transducers maximal resting (MARP) and squeezing pressures (MASP) can be obtained. The length of the anal canal can be measured. The distension or inhibition reflex can be demonstrated by a rectal balloon (Felt-Bersma 1990).

Treatment of pelvic organ prolapse

Nonsurgical treatment

Topical estrogen treatment can benefit many women with POP by relieving atrophic vaginitis (Tooze-Hobson et al. 1998). One placebo-controlled study showed that patients with preoperative topical estrogen had fewer urinary tract infections postoperatively (Fielding et al. 1992). Pelvic muscle exercises are widely accepted as treatment for urinary incontinence, but data on their usefulness in POP is lacking (Cundiff and Addison 1998). Observation is an option for patients with mild symptoms. Botulinum toxin has been shown to relieve obstructed defecation related to rectocele especially in patients with puborectalis muscle contraction syndrome (Maria et al. 2001).

The pessary is the mainstay of nonsurgical therapy for POP (Cundiff and Addison 1998). Sulak and associates (1993) suggested three groups of patients suitable for therapy in POP: 1. Poor medical status 2. Patients awaiting surgery 3. Patients declining surgery. There are many types of pessaries, the main categories being support and space-filling pessaries (Cundiff and Addison 1998).

Sulak's group (1993) reported that 62 % of patients declining surgery continued to use a pessary because of being relieved from their complaints. The authors stated that pessary worked best for women with cystocele and uterine or vaginal vault prolapse. In their opinion, patients with rectocele do not experience as good symptomatic relief. Handa and Jones (2002) reported that pessaries to some extent prevented worsening of prolapse and suggested that pessary support of the pelvic organs might allow recovery from passive stretch, resulting in improved muscular support.

Surgical treatment of uterine procidentia and vaginal vault prolapse

Abdominal sacral colpopexy

“The golden standard” for abdominal operations is abdominal sacral colpopexy. This is held to be the most effective procedure and it also facilitates concomitant surgery for pelvic pathology. It is further claimed to be superior in preserving coital function. The major disadvantage of the abdominal approach is the increased morbidity associated with a laparotomy (Tooze-Hobson et al. 1998). The vaginal vault is suspended retroperitoneally to the sacral promontorium with synthetic mesh or biological materials and the pouch of Douglas is obliterated (Kauppila et al. 1986a, Timmons et al. 1992, Virtanen et al. 1994, Tooze-Hobson et al. 1998, Koduri and Sand 2000, Carey and Dwyer 2001). Vaginal anterior or posterior repair should when indicated be performed before the abdominal part of the operation (Kauppila et al. 1986a and b, Harris and Bent 1990, Nichols 1992). Abdominal sacral colpopexy carries a risk of life-threatening hemorrhage and a 3 % incidence of mesh erosion, and if the combined abdominovaginal approach is used the risk of erosion is much higher (Timmons and Addison 1997, Timmons et al. 1992, Visco et al. 2001). Vertebral osteomyelitis necessitating laminectomy has also been reported (Beloosesky et al. 2002).

Benson and colleagues (1996) carried out a prospective, randomized study comparing bilateral SSLF with abdominal sacral colpopexy concomitantly with paravaginal repair. Subsequent surgery for recurrent prolapse was performed in 29 % of women undergoing SSLF and in 16 % undergoing abdominal surgery, the incidence of subsequent incontinence being 44 % and 23 % for the respective study groups. However, the results were poor when compared to previous studies dealing with same procedures (Koduri and Sand 2000).

Hardiman and Drutz (1996) compared 130 patients undergoing SSLF and 80 abdominal sacral colpopexies with follow-up ranging from 6 months to 5 years. The recurrence rates for vault prolapse were 2.4 % and 1.3 % respectively; other forms of recurrences were not reported. One patient undergoing abdominal operation developed stress urinary incontinence postoperatively. The only significant difference in morbidity was greater blood loss in the patients undergoing abdominal surgery.

Holley and associates (1999) compared the cost-effectiveness of SSLF and sacral colpopexy. They estimated that the recurrence rate after SSLF would be 15 % and after sacral colpopexy 5 %. Other variables in their calculations were hospital stay, hospitalization charges and surgeons fees. Their results showed SSLF to be more cost-effective than abdominal sacral colpopexy.

A variety of other abdominal operations are employed, e.g. the Williams-Richardson operation, abdominal sacrouterine ligament fixation, abdominal sacrospinous colpopexy or suspension of the vaginal to the psoas muscle

(Addison and Timmons 1993, Hale and Rogers 1999, Donato and Waller-Smith 2002).

Laparoscopic approach

Laparoscopy is an approach to the abdominal cavity, which has the advantage of more rapid recovery, better cosmetic appearance, improved intraoperative visualization and hemostasis when compared to laparotomy. However, laparoscopy is technically challenging, calling for suturing skills, increased operating time early in the surgeon's experience and the use of disposable surgical instruments thus involving extra costs (Paraiso et al. 1999). Advocates of the laparoscopic technique have stated that clinical outcomes do not differ from those obtained by laparotomy if the surgical procedure is the same (Margossian et al. 1999). Some observational studies have been published quoting success rates similar to those by open technique, but studies, even retrospective, comparing this technique to laparotomy or vaginal surgery are lacking (Carey and Dwyer 2001, Weber 2003).

Vaginal sacrospinous ligament fixation

Richter and Albrich (1981) popularized SSLF in Europe, a procedure primarily introduced by Sederl (1958). In the United States Randall and Nichols reported the first results of this technique (Randall and Nichols 1971, Nichols 1982). SSLF was originally used to correct posthysterectomy vaginal vault prolapse and total procidentia with weak or atrophied cardinal-uterosacral complex. Indications have expanded to include posthysterectomy enterocele (Morley and DeLancey 1988) and controversial prophylactic procedure upon hysterectomy in patients at elevated risk of subsequent vault prolapse (Cruikshank and Cox 1990, Cruikshank 1991, Nichols 1992, Morley 1993, Colombo and Milani 1998). Treatment of almost invariably co-existing enterocele is of fundamental importance (Nichols 1982 and 1992, Morley 1993). As a vaginal procedure SSLF allows concurrent treatment of anterior and posterior vaginal wall prolapse, which is present in at least 2/3 of cases with total prolapse (DeLancey 1992a). Repairing all defects of the pelvic floor concomitantly is crucial for good outcomes (Shull 1999, Koduri and Sand 2000). A recent study of 695 patients by Cruikshank and Muniz (2003) nicely highlighted this fact; in their study better long-term outcomes were obtained when pelvic floor repair was performed concomitantly with SSLF than with SSLF and enterocele resection only. Other advantages of this technique include avoidance of laparotomy (or laparoscopy) and general anesthesia, resulting in fewer complications and less postoperative pain, greater cost-effectiveness (Holley et al. 1999), shorter hospital stay, decreased blood loss and preservation of coital function (Sze and Karram 1997, Tooze-Hobson et al. 1998).

The technique involves unilateral, usually right-sided, fixation of the vaginal apex to the sacrospinous ligament. The left side can be used as well and also bilateral fixation has been used, although its advantages have never been studied (Nichols 1982, Sze and Karram 1997). Modifications of this technique include the “Michigan approach” and anterior vaginal sacrospinous ligament fixation (Morley and DeLancey 1998, Winkler et al. 2000). A variety of instruments are available for perforating the ligament (Miyazaki 1987, Sharp 1993, Watson 1996, Veronikis and Nichols 1997, von Theobald et al. 1999, Cruikshank and Muniz 2003). In early studies absorbable sutures were used, but nowadays delayed absorbable or permanent sutures are favored (Sze and Karram 1997, Meschia et al. 1999, Lovatsis and Drutz 2002, Cruikshank and Muniz 2003). Use of synthetic mesh for attachment has also been reported (Cruikshank and Muniz 2003).

Results

Sze and Karram (1997) in a review article summarized results of studies published in peer-review journals. Results of this review and an additional 17 studies published in peer-review journals are available in Table 1. Long-term outcomes seem to be good and apical recurrences are not often seen. Cystocele is the most common recurrence, held to be caused by the retroverted vagina postoperatively (Porges and Smilen 1994, Cundiff and Addison 1998). However, Smilen and colleagues (1998) compared operations for POP with or without concomitant SSLF and noted no effect of SSLF on the incidence of subsequent cystocele.

Table 1. *Long-term outcomes of SSLF.*

Investigator	No. followed	Follow-up (months, mean or range)	Recurrence			Comment	Cured %
			Vault	Anterior wall	Posterior wall		
Sze and Karram (1997) Review of 19 articles	1062	1-132	32 (3)	81 (8)	24 (2)	56 (5) unspecified recurrences	82
Pasley (1995)	144	35	8 (6)	11 (7)	2 (1)		85
Sze et al. (1997)	75	24	4 (5)	16 (21)	1 (1)	72 % with concomitant needle suspension	71
Paraíso et al. (1996)	156	74	17 (11)	65 (42)	17 (11)	11 (7) reoperated	69
Hoffman et al. (1996)	39	29	2 (5)	2 (5)	0		90
Benson et al. (1996)	42	30	5 [†] (12)	12 [†] (29)	1 [†] (2)	14 (47) reoperated	67
Hardiman and Drutz (1996)	125	26	3 (2)	‡	‡		98
Colombo and Milani (1998)	62	82	5 (8)	9 (15)	3 (5)		73
Hewson (1998)	114	8-56	2 (2) [†]	6 (5) [†]	‡	8 (7) reoperated	‡
Özcan et al. (1999)	54	28	2 (4)	3 (6)	1 (2)	5 (9) enteroceles	80
Meschia et al. (1999)	91	43	6 (7)	41 (45)	9 (10)	5 (5) enteroceles	‡
Lantzsch et al. (2001)	123	58	4 (3)	10 (8)	1 (1)	1 (1) enterocele	87
Goldberg et al. (2001)*	92	53	‡	‡	‡	14 (15) reoperated	‡
Maher et al. (2001)	36	19	1 (3)	9 (25)	2 (6)		67
Guner et al. (2001)	26	31	0	2 (8)	0	1 (4) enterocele	88
Lovatsis and Drutz (2002)	216	6-60	6 (3)	14 (6)	5 (2)		88
Hefni et al. (2003)	106	34	7 (7)	12 (11)	0	5 (5) reoperated, 56 % with uterine conservation	92
Cruikshank and Muniz (2003)	695	43	36 (5)	88 (13)	‡		‡
Total	3258		140 (4)	381 (13)	66 (3)		67-98

The figures are n (%) unless otherwise indicated

*Patients with posterior sacrospinous suspension included

†number of patients reoperated

‡not reported

Complications

The complications of SSLF reported in the literature are summarized in Table 2. Intraoperative complications, although infrequent, include severe, even life-threatening hemorrhage from laceration of the hypogastric venous plexus or pudendal vein. Hemorrhage can be controlled by tight vaginal packing, arterial ligation or hemo-clips (Sze and Karram 1997, Cruikshank and Muniz 2003). Injuries to other pelvic organs such as bladder and rectum have also been reported (Sze and Karram 1997). As an anecdotal case Farrell and associates (1991) described massive evisceration of the small bowel through the vaginal vault.

Transient gluteal or buttock pain due to direct nerve injury or hematoma or suture abscess is infrequently seen (Table 2). If the pain is immediate and severe or associated with paresthesia, immediate reoperation and reposition of the suture more medially is recommended (Nichols 1981, Sze and Karram 1997). However, Alevizon and Finan (1996) reported that symptoms of severe pudendal neuropathy were relieved two years after a primary operation by removal of the suture.

Urinary incontinence is infrequently reported after SSLF (Sze and Karram 1997). It may result from either vesicourethral junction straightening or from a significant reduction in urethral closure pressure. The incidence of voiding dysfunction has varied from 5.5 to 16 % (Table 2). Voiding dysfunction is usually connected with concurrent additional operations such as anterior colporrhaphy or Burch colposuspension (Nichols 1981, Lantzsich et al. 2000).

Sexual dysfunction has been described as one of the complications following SSLF (Timmons et al. 1992, Cundiff and Addison 1998). Given and associates (1993) reported shorter vagina after SSLF as against abdominal operation but due to the small number of patients the difference was not statistically significant. On the other hand Weber and colleagues (1995) noted that vaginal length or introital caliber surprisingly did not correlate well with sexual function. Holley and associates (1996) in their survey of patients undergoing SSLF, noted dyspareunia to be present only if vaginal narrowing had occurred.

Table 2. *Intra- and postoperative complications related to SSLF.*

Investigator	No of patients	Cysto- or enterotomy	Transfusion required	Urinary retention	Cuff infection	Urinary tract infection	Nerve injury	Cardiovascular complications	Death
Sze and Karam (1997) Review of 18 articles	1080	9 (0.8)	27 (2.5)	*	*	*	39 (3.6)	5 (0.5)	2 (0.2)
Pasley (1995)	156	3 (2)	3 (2)	15 (10)	3 (2)	16 (10)	1 (0.6)	1 (0.6)	1 (0.6)
Paraiso et al. (1996)	243	*	20 (8)	30 (12)	14 (6) [†]	9 (4)	1 (0.4)	10 (4)	*
Hoffman et al. (1996)	45	1 (2)	2 (4)	*	8 (18)	*	0	*	*
Benson et al. (1996)	42	1 (2)	0	32 (75)	2 (5) [†]	9 (21)	*	*	*
Hardiman and Drutz (1996)	125	*	*	*	13 (10) [†]	10 (8)	0	0	0
Colombo and Milani (1998)	62	0	3 (5)	*	*	*	*	*	*
Hewson (1998)	135	*	0	*	2 (1.5)	*	*	*	0
Özcan et al. (1999)	54	1 (1.8)	0	3 (5.5)	1 (1.8)	3 (5.5)	1 (1.8)	0	0
Meschia et al. (1999)	103	*	0	7 (7)	14 (14) [†]	*	6 (6)	*	*
Guner et al. (2001)	26	0	*	0	0	2 (8)	5 (19)	0	0
Lantzsch et al. (2001)	200	*	1 (0.5)	11 (5.5)	*	16 (8)	15 (8)	3 (1.5)	1 (0.5)
Maher et al. 2001	36	*	1 (3)	*	*	*	7 (36)	0	*
Lovatsis and Drutz (2002)	293	0	*	*	1 (0.3)	*	19 (6)	*	0
Hefni et al. (2003)	109	1 (0.9)	2 (1.8)	3 (2.8)	3 (2.8) [†]	6 (5.5)	4 (3.7)	1 (0.9)	0
Total	2709	16 (0.9)	59 (2.6)	101 (11)	61 (4.6)	71 (7.4)	98 (3.9)	20 (0.9)	4 (0.2)

The values are n (%)

*=not reported

[†] Febrile morbidity

Other vaginal procedures

Numerous operations in addition to SSLF have been described for the treatment of vaginal vault prolapse and massive genital prolapse (Sze and Karram 1997). McCall (1957) described suspension of the vaginal vault to the origins of the uterosacral ligament and obliteration of the cul-de-sac. The modification of this technique has been retrospectively compared to SSLF with similar overall recurrence rates, but with higher frequency of anterior prolapse after SSLF (Colombo and Milani 1998).

In iliococcygeus fixation the vaginal vault is fixed to the iliococcygeus fascia bilaterally immediately anterior to the ischial spine. This is claimed to be an easier and safer treatment option resulting in less frequent recurrent cystocele (Meeks et al. 1994, Carey and Dwyer 2001). In a retrospective comparison it showed no advantage over SSLF (Maher et al. 2001).

Patients with massive genital prolapse are often elderly and may have associated medical problems which make them poor operative candidates (Harris and Bent 1990, Nichols 1992, Olsen et al. 1997). Obliterative procedures, e.g. colpocleisis for vault prolapse and Neugebauer-LeFort operation for uterovaginal prolapse, have been recommended, but their role in modern treatment of genital prolapse is very limited (Cundiff and Addison 1998, Tooze-Hobson et al. 1998).

Petros (1998) reported a new technique based on an integral theory for vaginal vault prolapse: infracoccygeal sacropexy, nowadays known as posterior intravaginal slingplasty (IVS) (Farnsworth 2002). The objective in this operation is to recreate artificial uterosacral neoligaments to support the vagina (Petros 1998). Two 0.5-cm skin incisions are made bilaterally 2 cm lateral and below the external anal sphincter. A specific tunneller is pushed through the levator plate to the opening in the vagina vault. A tape is brought to the vaginal incision bilaterally and attached to the vaginal vault, but the ends of the tape are left entirely free and unfixed (Petros 2001b, Farnsworth 2002).

There are two papers dealing with this technique: Petros (2001b) reported on 75 patients of whom 53 % were followed for 4.5 years or more. At two years, 30 % of these patients were diagnosed as having recurrence at some site: 6 % vault prolapse, 19 % anterior vagina wall and 6 % posterior vaginal wall. After two years no recurrences were noted. Farnsworth (2002) described 93 patients with a median follow-up of 12 months and reported a cure rate of 91 %. All the patients in these two series were discharged within 24 hours. Petros (1998) reported two rectum perforations and Farnsworth (2002) one, which were treated by reinsertion of the tunneller and antibiotics. Both reported a 5 % incidence of tape rejection, total or partial. No adverse effects on sexual function were noted.

Surgical treatment of rectocele

Vaginal posterior colporrhaphy

Gynecologists have used posterior colporrhaphy for a century with few modifications (Brubaker 1996). The operative technique is usually as follows: A transverse incision is made at the mucocutaneous junction and the vaginal wall is separated from the perineal body and the posterior vaginal wall is opened beyond the top of the rectocele. The rectovaginal septum is separated from the vaginal epithelium and excess vaginal wall then excised. The rectovaginal septum is closed as a separate layer and thereafter the vaginal wall (Nichols 1991a and b). Another option is to remove an appropriate width of full-thickness vaginal wall and close the vaginal wall with a single layer of stitches (Nichols 1991a, Nichols and Randal 1996, Kobashi and Leach 2000).

Many authors describe routine plication of the levator muscles as part of this procedure (Cundiff and Addison 1998, Kobashi and Leach 2000, Segal and Karram 2002). In order to avoid vaginal tightening and postoperative pain and dyspareunia Nichols (1991a), Nichols and Genadry (1993) and Nichols and Randal (1996) have suggested avoiding suturing the levator muscles *per se*. Intra- and postoperative complications have occurred only infrequently. Hematomas, transient urinary retention and infections have been reported (Arnold et al. 1990, Lopéz et al. 2001, Rovner and Ginsberg 2001). Also rectal injuries, subsequent fistula formation and vaginal inclusion have been reported (Kobashi and Leach 2000, Rovner and Ginsberg 2001).

The results of this technique are summarized in Table 3. There are divergences in the techniques used and also in patient assessment; both objective and subjective measures have been employed. Additionally, the preoperative status has not always been reported. Dyspareunia has been the major concern after posterior colporrhaphy, Francis and Jeffcoate (1961) reported dyspareunia rate of 50 % after posterior colpoperineorrhaphy and Haase and Skibsted (1988) 21 % after colpoperineoplasty. However, the high rate of postoperative dyspareunia is thought to be caused by tight levator plication causing atrophy of muscles and scarring (Nichols and Genadry 1993, Kahn and Stanton 1997, Segal and Karram 2002) in conjunction with anterior colporrhaphy (Haase and Skibsted 1988) and may thus be avoided.

Table 3. *Summary of outcomes of posterior colporrhaphy.*

Author	No	Length of follow-up (months)	Indication	Results	Evaluation	Comments
Arnold et al. 1990	29	≥24	Constipation 75 %, Digitalization 20 %	Satisfied 77 % Constipation relieved 46 % Sexual dysfunction 23 %	Telephone interview	Retrospective comparison to transanal technique
Mellgren et al. 1995	25	12	Constipation 96 % Digitalization 48 % Rectocele 100 % (defecography)	Constipation improved 88 % Recurrence 4 % Dyspareunia 19 % (6 % preop)	Interview, physical exam and defecography	Prospective study
Infantino et al. 1995	8	37	Difficult evacuation 100 % Rectocele 100 % (proctogram) Digitalization 50 %	Cured 50 % Improved 25 % Recurrence 12.5 % Dyspareunia 0 %	Interview, physical exam, electrophysiology, anorectal manometry, colon-transit and defecography	Retrospective comparison to transanal technique (Block's technique)
Kahn and Stanton 1997	171	43	Lump, pressure 94 % Incomplete evacuation 27 %	Anatomical cure 76 % Constipation, incomplete evacuation, digitalization and dyspareunia rates increased	Clinical examination 82 % Telephone interview 18 %	Retrospective study
López et al. 2001	24	61	Constipation 96 % Digitalization 48 % Rectocele 100 % (defecography)	Rectal emptying improved 91 % Recurrence 4 % (clinical) and 17 % (defecography) Dyspareunia 33 % (6 % preop)	Interview, physical exam, electrophysiology, anorectal manometry, colon-transit and defecography	Prospective study, short term results reported by Mellgren et al. (1995)
Paraiso et al. 2001	102	12 (65%) 6 (35 %)	Rectocele 88 % (Clinical) Straining 76 % Digitalization 45 %	Satisfactory outcome 88 % (anatomical) Bowel function improvement "significant" Dyspareunia 12 % (2% preop)	Interview, VAS, clinical examination	Prospective longitudinal study
Sloots et al. 2003	14	8 (3-14)	Rectocele 100 % Difficulty in evacuation 100 %	Rectocele absent 70 % Rectocele downgraded 21 % Symptom improvement 70 % Dyspareunia 21 % (pre- and post) Fecal incontinence "unaltered" No change in manometry values	Questionnaires, clinical examination, anorectal manometry, endoanal ultrasonography, colon transit, barostat	Prospective study, healthy controls

Rectocele is usually associated with other forms of pelvic organ prolapse, as is the case with uterine procidentia and vault prolapse (DeLancey 1992a, Brubaker 1996). This may be a confounding factor when assessing results of any kind of technique. In all the surveys referred to in Table 3 patients concurrently underwent other forms of pelvic floor repair than posterior colporrhaphy only.

The effects on bowel function have differed widely in different studies (Table 3) unlike the case with anatomic cure. Bowel function symptoms may be attributable to other factors, in which case rectocele repair does not alleviate symptoms. Anorectal investigations may be helpful in selecting patients who will benefit from this operation (Brubaker 1996, Kahn and Stanton 1997, Segal and Karram 1997).

Transanal rectoceleplasty

Sullivan and associates (1968) first described a totally transrectal operation for rectocele. It consisted of transverse and longitudinal plication of the rectal wall following stripping of excess anterior rectal mucosa. Most techniques expose the inner circular muscle and various minor modifications of this technique have been evolved (Kahn and Stanton 1998). This technique is also used in males with rectocele (Kahn and Stanton 1998). Also combined transanal and transvaginal technique has been utilized (van Dam 1997).

Kahn and Stanton (1998), in a review article summarized published articles on transanal technique and found comparison among them particularly difficult in that patients might be of either sex and indications and patient assessments varied. Most of the studies showed improvement of symptoms in more than half of the patients, but anatomical results were infrequently reported. Results of prospective studies concerning transanal technique are summarized in Table 4.

Transanal rectoceleplasty is well tolerated and postoperative complications are seen infrequently. Boccasanta and colleagues (2001) reported suture dehiscence leading to pelvic sepsis and treatment with transient stoma in 1 of 141 patients. A group under Khubchandani (1997) reported a 0.9 % incidence of rectovaginal fistula in a series of 123 patients and Murthy and associates (1996) reported one fistula in 31 patients operated on. Other complications include rectal mucosal bleeding, infection and urinary retention (Arnold et al. 1990, Janssen and van Dijke 1994, Karlbom et al. 1996, Tjandra et al. 1999), but Ho and group (1998) reported that no complications occurred.

The last mentioned authors (Ho et al 1998) suggested that transanal surgery might adversely affect anal sphincter function. In anorectal manometry they noted deterioration in MARP and MASP values 6 months after surgery. However, none of the patients had *de novo* fecal incontinence. Van Dam and colleagues (2000) prospectively evaluated 89 women undergoing combined rectocele repair. Fecal continence deteriorated in seven patients after surgery.

Table 4. *Outcomes of prospective studies on transanal rectocele repair.*

Author	N:o	Follow-up	Indication	Assessment	Results	Comment
Janssen and van Dijke (1994)	76	12 months	Rectocele 100 % (clinical) Obstructed defecation 72 % Fecal incontinence 40 %	Interview, defecation diary, clinical exam, defecography (62 %), anorectal manometry	50 % no complaints 16 % obstructed defecation Incontinence 9 %	64 females 12 males
Murthy et al. (1996)	33	31 months (mean)	Vaginal bulge 61% Constipation 35 % Incontinence 29 %	Interview, clinical exam, defecography	Anatomical cure 80 % Constipation 12 % Incontinence 8 %	32 females 1 male
van Dam et al. (1997)	74	58 months (median)	Rectocele 100 % Straining 95 % Incomplete evacuation 93 % Digitalization 93 %	Questionnaire, clinical exam, defecography	Subjective: Excellent 50 % Good 18 % Rectocele in defecography 0 %	Postoperative defecography at 6 mo Combined transanal/transvaginal technique
Ho et al. (1998)	21	6 months	Straining 91 % Digitalization 76 %	Questionnaire, clinical exam, defecography, anomanometry	Straining 14 % Digitalization 0 % Improvement in all patients	No incontinence pre- or postoperatively, but deterioration of anal sphincter pressures
Tjandra et al. (1999)	59	19 months (median)	Difficult evacuation 100 % Vaginal bulge 88 % Digitalization 45 %	Questionnaire, clinical exam, anomanometry, defecography	Anatomical cure 76 % Constipation relieved 54 % Digitalization 8 %	Poor results correlated with anismus

Manometric studies revealed a significant decline in mean MARP and MASP by 18 % and 16 %, respectively. MARP values gradually improved, whereas MASP values did not during a follow-up of 24 months. A likely explanation for these changes in anorectal manometry is the use of an anal retractor, which may stretch and damage the anal sphincter. However Janssen and van Dijke (1994) and Murthy and associates (1996) both listed fecal incontinence as one of the indications for transanal rectocele repair and did not report deterioration but rather improvement in fecal continence.

Two studies comparing transvaginal and transanal techniques, both retrospective, are available. Arnold and associates (1990) compared 29 transvaginal rectocele repairs to 35 transanal. The only statistically significant difference between the groups was in the incidence of rectal pain, 32 % versus 4 %, respectively. Interestingly, the postoperative “sexual dysfunction” rates were 23 % and 21 % for the respective study groups. In fact, this is the only study reporting sexual dysfunction rates after transanal operation. Another study is reported by Infantino and colleagues (1995), including 8 patients undergoing vaginal and 13 patients transanal surgery. No differences in outcomes were reported; no data on sexual function were shown. Van Dam and colleagues (2000) reported a 41 % incidence of dyspareunia after combined transanal and transvaginal technique.

Site-specific rectocele repair

Richardson (1993) reported that rectocele is caused by isolated tears in the rectovaginal septum: these tears can be vertical or horizontal, lateral or midline and also U-shaped. Transverse separation immediately above the rectovaginal septum’s attachment to the perineal body is the most common type. The principle in this technique, which he called “site-specific rectocele repair”, is to identify the tear and suture the edges of it. The vaginal wall is opened as in posterior colporrhaphy, whereafter surgeon’s finger rectally pulls the rectum anteriorly to facilitate identifying the tears. Levator muscle stitches are not used.

After the description of this technique a few follow-up studies have been published naming the procedure: “discrete defect repair”, “defect-specific repair”, “rectovaginal reattachment” or “fascial technique” (Cundiff et al. 1998, Kenton et al. 1999, Porter et al. 1999, Glavind and Madsen 2000, Singh et al. 2003). These studies report anatomic cure rates from 82-100 % with follow-up lengths varying from 3 to 18 months. Improvement in defecation and sexual function has been reported between 44 and 85 % and 38 to 92 % of the patients, respectively. Although improved, the absolute percentages of dyspareunia do not differ from figures with posterior colporrhaphy, varying from 12-46 %. This technique has even been recommended as a standard operative treatment for rectocele (Lukacz and Lubner 2002), but studies comparing this operation with other techniques are lacking.

Kohli and Miklos (2003) reported their modification of site-specific repair augmented by dermal allograft. After an average follow-up of 13 months in 30 women the cure rate assessed by values of point Ap was 93 %. The rate of symptom improvement was not reported; there were no cases of postoperative dyspareunia or graft-related complications. In as far as this is a novel technique, further studies are needed to assess efficacy and adverse effects as well as randomized comparison to older techniques.

Other techniques

Anterior levatorplasty, primarily indicated for fecal incontinence, is a perineal approach favored by coloproctologists. One study reported 82 % general satisfaction with a mean follow-up of 3.5 years (Lamah et al. 2001), but group under Boccasanta (2001) reported 17 % dyspareunia and a 16 % delayed wound-healing rate. Also synthetic meshes have been applied transperineally (Watson et al. 1996, Boccasanta et al. 2001).

The use of mesh has been suggested as a means to improve the strength of the repair. However, the mesh has been associated with vaginal erosion, seroma and sinus formation, shrinkage and infection (Cervigni and Natale 2001, Segal and Karram 2002). Papers dealing with rectocele repair with mesh are scant (Cervigni and Natale 2001). Sand and associates (2001) carried out a prospective randomized study comparing anterior and posterior repair with or without polyglactin 910 mesh. They found mesh repair to be effective in preventing recurrent cystoceles but not rectoceles.

Baessler and Schuessler (2001) repaired rectocele concomitantly with open abdominal sacral colpopexy by extending the mesh to cover posterior vaginal wall defects. Fifty-seven % recurred and the authors switched to vaginal defect-specific repair. A laparoscopic technique using sutures (Paraiso et al. 1999, Seman et al. 2003) or synthetic meshes (Lyons and Winer 1997) has been described. Lyons and Winer (1997) reported an 80 % satisfaction rate at one year postoperatively with 20 patients. They used polyglactin mesh. However, comparative studies are lacking and the effectiveness of this approach is yet to be shown (Weber 2003).

Advocates of posterior IVS (Petros 2001b, Farnsworth 2002) use a method called “bridge” for posterior repair. With this technique the idea is to restore the laterally displaced rectovaginal fascia to its correct anatomical position, thus restoring the ability of the levator plate to stretch the vagina backwards (Petros 2001a). Another principle is to avoid surgery on the perineal skin and the distal 1 cm of the vagina. Two parallel incisions 1 to 1.5 cm apart are made in the posterior vagina wall creating a “bridge”. The vaginal epithelium overlying the bridge is destroyed by diathermy and the rectovaginal fascia is approximated to midline with a series of lateral “tension” sutures and the vagina epithelium closed. Petros (2001b) reported on 67 patients treated with “bridge” repair concomitantly with IVS and found three (4 %) recurrences.

AIMS OF THE STUDY

The main purpose here was to evaluate results of vaginal sacrospinous ligament fixation with pelvic floor repair and to compare two current approaches to rectocele repair. The specific aims were:

1. To assess factors predisposing to recurrence of prolapse and to evaluate the long-term efficacy of sacrospinous ligament fixation with pelvic floor reconstruction for uterovaginal and vaginal vault prolapse (I)
2. To study the feasibility of sacrospinous ligament fixation for a specific subgroup of women aged 80 years or more (II)
3. To study the operative morbidity associated with sacrospinous ligament fixation with or without concomitant vaginal hysterectomy (III)
4. To compare the long-term efficacy of sacrospinous ligament fixation to abdominal sacral colpopexy for posthysterectomy vaginal vault prolapse (IV)
5. To compare vaginal posterior colporrhaphy and transanal rectoceleplasty as modes of rectocele repair (V)

PATIENTS AND METHODS

Patients

The patient characteristics and length of follow-up in the original publications are summarized in Table 5. The cohort in study I comprised all 138 patients who had undergone SSLF in Tampere University Hospital between June 1986 and March 2000. The indication for operation was symptomatic vaginal vault or massive genital prolapse. Twenty-five women aged 80 years or more at the date of operation comprised the patients in study II.

Table 5. *Characteristics of patients and length of follow-up periods in the original publications.*

Study	Number of patients	Age (years)	Nonparous	Follow-up (months)	Previous prolapse surgery
I	138	71±9 (47-93)	12 (9)	24 (1-141) [†]	57 (41)
II	25*	83±3 (80-93)	3 (12)	19 (2-113) [†]	4 (16)
III	30* SSLF	71±8 (55-82)	0	-	14 (47)
	30* SSLF+VH	70±9 (49-83)	2 (7)	-	5 (17)
IV	26* SSLF	67±11 (47-82)	1 (4)	69±24 (46-141)	7 (27)
	26 ASC	67±11 (48-85)	5 (19)	105±31 (62-179)	6 (23)
V	15 TV	59±11 (42-74)	0	12 (all)	1 (7)
	15 TA	62±7 (53-75)	0	12 (all)	1 (7)

The values are mean±S.D. (range) or n (%) unless otherwise indicated

*Patients included in study I

[†] median (range)

TV=transvaginal posterior colporrhaphy

TA=transanal rectoceleplasty

Twenty-four (17 %) out of 138 who underwent SSLF (studies I-IV) had coronary heart disease, 33 (24 %) arterial hypertension, six (4 %) pulmonary diseases and eight (6 %) diabetes treated with insulin. One (4 %) out of 26 patients undergoing ASC (study IV) had coronary heart disease and three (12 %) had arterial hypertension.

Two (7 %) out of 30 patients undergoing rectocele repair (study V) had coronary heart disease, one cardiac insufficiency and eight (27 %) arterial hypertension.

For study III, 30 consecutive patients operated on for posthysterectomy vaginal vault prolapse were matched in respect of nearest date of operation to 30 patients operated on for massive uterovaginal prolapse.

The cohort in study IV comprised 52 women operated on for posthysterectomy vaginal vault prolapse in Tampere University Hospital between October 1984 and January 1995. Twenty-six patients who had undergone abdominal sacral colpopexy were matched with 26 patients who underwent SSLF. The primary matching criterion was age at operation, the secondary the nearest date of operation of the counterparts. The study designs in studies I-IV were retrospective.

Study V was a prospective, randomized study. The study population comprised all females attending the Department of Obstetrics and Gynecology or Surgery in Tampere University Hospital for rectocele between January 1998 and March 2001. Patients with other forms of genital prolapse requiring surgery or with any signs of impaired anal sphincter function were excluded from the study. Eventually, 42 patients were candidates for the study. Twelve of these were excluded because of impaired anal sphincter function, leaving thirty patients included in the study. Thirty women with symptomatic, radiologically confirmed rectoceles were enrolled. After enrolment, an independent nurse performed randomization blindly by picking a card labeled with either of the operations from an envelope.

Patient assessment

Studies I-IV

Preoperative assessment

Data on patient characteristics, preoperative symptoms and status, details of surgery, early complications, hospitalization and immediate recovery were evaluated from the hospital charts.

In study I the preoperative extent of prolapse was graded first, second, third or fourth grade. In patients with grade 1 prolapse, the leading part of the prolapse descended to midvagina level, with grade 2 at the vaginal introitus and grade 3 outside the introitus. Grade 4 prolapse included total procidentia of the uterus or total eversion of the vaginal vault. In study II, only the proportion of procidentia

or total vault prolapse was noted. In studies III and IV, the previously mentioned grades 3 and 4 were combined.

Follow-up

All patients who had undergone SSLF in Tampere University Hospital were asked to participate in follow-up examinations (studies I, II and IV). The length of follow-up was calculated from the date of surgery to the date of last examination. A total of 112 patients were alive and 87 participated. Additional 21 patients declined examination, but were interviewed by telephone. Fourteen of the 26 deceased women had undergone examination in the same institute and the follow-up information was collected from the charts. In all, follow-up information was available on 122 (88 %) out of 138 patients and the median length of follow-up was 24 months. Follow-up information on patients who had undergone ASC (study IV) was collected in the same manner and 20 (77 %) out of 26 patients attended for clinical examination or consented to telephone interview. The mean length of follow-up was 105 months (Table 5).

Follow-up interviews were undertaken with the same questionnaire. The questions covered recurrence or absence of preoperative symptoms, urinary and bowel function, urinary incontinence and sexual activity and function. Women who had vaginal intercourse monthly or more often were considered sexually active. Sexually active patients were asked about frequency of intercourse, dyspareunia and effects of operation on coital function, whereas sexually inactive patients were asked the reason for inactivity.

Pelvic organ status at the follow-up examination was assessed as recommended by ICS (Bump et al. 1996). The measurements were carried out with a vaginal probe marked in centimeters with the patient supine under maximal straining. The vagina was considered constricted if two fingers of the examining hand could not be inserted without pain. The same specialist examined and interviewed the patients.

Failure of surgery was considered to entail any symptomatic vaginal vault or pelvic floor prolapse or any stage II-IV prolapse with or without symptoms.

Study V

The patients in this study were prospectively evaluated by similar methods both before operation and at 12-month follow-up examination. All interviews were conducted by the same gynecologist.

Questionnaires

A questionnaire was used to evaluate patients' symptoms. Questions covered symptoms of pelvic heaviness, bearing down sensation, vaginal bulge, difficulties in rectal emptying, need to assist rectal emptying digitally, fecal incontinence or other symptoms related to rectocele.

For a period of two weeks patients daily reported frequency of defecation, difficulties in rectal emptying (no difficulties-incomplete emptying-digital assistance), pain at defecation (yes-no), anal continence (normal-gas incontinence-incontinence with liquid stool-incontinence with solid stool) and use of laxatives. A symptom was considered positive if it was reported to be present on more than 50 % of days or defecations.

Clinical examination

Gynecologic examination was performed and reported with these patients as in studies I, II and IV. A coloproctologist examined the patients before randomization. Special attention was paid to anal sphincter function and forms of anorectal pathology other than rectocele.

Imaging studies

Defecography was used to measure the size of rectocele by the following technique. The rectum was filled with 200 ml of a suspension of barium sulfate, formed by mixing Mixobar esophagus 1g/ml and Mixobar colon 1 g/ml (Astra Tech co. Södertälje, Sweden). The patient was positioned on a toilet seat with a radiolucent rim. During relaxation a direct lateral picture was obtained, followed by pictures of the patient pinching the rectum tightly and during straining. The examination was also videotaped. Measurements included the anorectal angle and the size of the rectocele. The size of the rectocele was determined by measuring the distance between the deepest pouch of the rectocele and the anterior surface of the anal canal. A depth of pouch more than 2 cm was considered to constitute rectocele.

A colon transit study was performed to investigate bowel function and emptying. A capsule containing 25 radiodense rings was given to the patient, and after a five-day period a native abdomen film was taken. The number of rings remaining and the position of the rings were detected and analyzed. Retention of more than 40 % of the markers was considered pathological.

Anorectal manometry

Anal sphincter function was studied by stationary anorectal manometry using a polyvinyl catheter with an external diameter of 5 mm (Vygon, Ecoen, France). The lumen was perfused with distilled water at a rate of 0.5 ml/min using a low-compliance pneumohydraulic capillary infusion system (Biomedical Perfusion pump, J.S. Biomedicals, Ventura, Ca). The pressure channel was connected to an external transducer (Medex Inc., Rosendale, England) with output on a physiograph recorder (PC Polygram VIII, Synectics Medical Ltd., Stockholm, Sweden). With patients lying in left lateral position the anal canal resting and squeeze pressures were determined by a station pull-through technique at 0.5 cm increments. Sphincter relaxation was studied by transient injections of air (50 ml) into a rectal balloon positioned 10 cm from the anal verge.

Operative techniques

Vaginal sacrospinous ligament fixation (studies I-IV)

The goal here was to accomplish a total pelvic reconstruction. The technique utilized was mainly the same as described by Nichols (1982). The uterus or the uterine stump, if present, was first extirpated and the enterocele sac ligated as high as possible. If the indication for surgery was posthysterectomy prolapse, the operation began with incision of the vaginal vault and deliberating and opening of the enterocele sac. The peritoneum was closed as high as possible with a purse-string suture and the enterocele sac excised. Anterior colporrhaphy, when indicated, was performed at this stage of the operation. If posterior colporrhaphy was indicated, the posterior vaginal wall was opened and the pararectal space dissected, mostly bluntly and the sacrospinous ligament exposed. If posterior colporrhaphy was not indicated the pararectal space was entered via an incision in the vaginal vault. A Deschamps ligature carrier was introduced through the ligament and the suture was cut at midpoint making two stitches available. Polyglycolic acid suture (#2 Vicryl®; Johnson & Johnson, Brussels, Belgium) was used in 27 % of the cases and delayed polyglyconate monofilament absorbable suture (#1 PDS®; Ethicon, Norderstedt, Germany) in 73 %. The stitches were sewn to both sides of the vaginal vault, whereafter closure of the posterior vaginal wall was begun. When posterior vaginal wall closure was at the midvagina level, the fixation stitches were firmly tied avoiding any suture bridge between the vaginal vault and the ligament. Thereafter the rest of the posterior vaginal wall was closed normally (Fig. 4). A vaginal pack and urine catheter was placed to be removed within 24 hours.

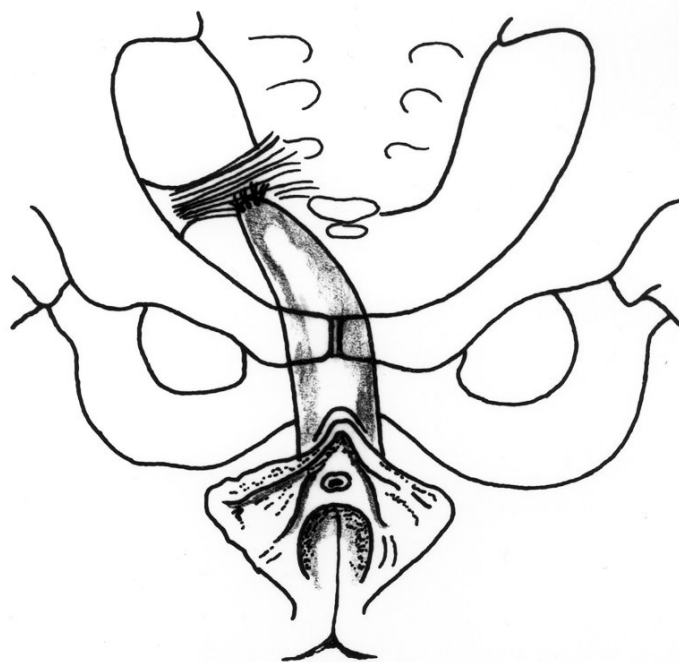


Figure 4. *Schematic drawing of the SSLF. The vaginal vault deviates to the right side after suspension to the right sacrospinous ligament. Reproduced with permission of Blackwell Publishing Ltd, from Heinonen PK (1992): Transvaginal sacrospinous colpopexy for vaginal vault and complete genital prolapse in aged women. Acta Obstet Gynecol Scand 71:377-381.*

Four surgeons performed the operations. Antithrombotic prophylaxis was used in 29 % and intravenous antibiotic prophylaxis in 26 % of cases. The fixation was performed on the right side in 130 (94 %) patients; no bilateral fixations were performed. Spinal anesthesia was used in 92 % of cases, other operations were performed under general anesthesia. The median hospital stay was seven days. During the study period there was a tendency for a shorter hospital stay; in the early years of the study patients recovering without complications were discharged on the fifth postoperative day, currently on the second.

Abdominal sacral colpopexy (study IV)

The procedures here were undertaken under general anesthesia by four surgeons. The abdominal cavity was entered through a Pfannenstiel or vertical midline

incision. The rectum was dislocated to the left and the peritoneum overlying the sacrum and vaginal apex was incised. The vaginal apex was fixated directly to the presacral fascia in four (15 %) out of 26 patients with absorbable polyglycolic acid sutures (#1 Dexon®, Davis and Geck, Gosport, United Kingdom or #1 Vicryl®, Johnson & Johnson, Brussels, Belgium), because the vaginal vault reached the promontorium without the graft. The enterocele sac was excised and the peritoneum closed.

In fourteen (54 %) patients a fascial strip from the rectus sheath was used to attach the vagina to the sacrum. In other cases non-absorbable polyester fiber mesh (Mersilene®, Ethicon, Somerville, N.J., five cases [19 %]) or homologous dura mater graft (Lyodura®, B. Braun Melsungen AG/Germany in three cases [12 %]) was attached to the vaginal apex and the periosteum of the sacrum and then re-peritonealised. The incision was closed normally and a urine catheter placed and removed within 24 hours.

Vaginal posterior colporrhaphy (study V)

A transverse incision was made at the mucocutaneous junction and the posterior vaginal wall opened at the midline cranially to the rectocele to the posterior fornix or one cm from the vaginal apex. Local anesthetics or vasoconstrictors were not used. The rectum and the rectovaginal fascia were dissected from the vaginal wall. In two cases, enterocele was noted, dissected, opened and closed with a purse string suture. The rectovaginal fascia was united in midline with interrupted absorbable polyglycolic acid sutures (#2-0 Vicryl®, Johnson & Johnson, Brussels, Belgium). The perineorrhaphy was performed with one or two horizontal sutures without dissection or suturing of the levator muscles. Excess vaginal mucosa was excised and the vaginal wall closed with running absorbable polyglycolic acid suture (#3-0 Vicryl®; Johnson & Johnson, Brussels, Belgium). Special attention was paid to avoiding vaginal narrowing, the vaginal caliber at that phase was two to three finger-breadths. A vaginal pack was inserted and removed within 24 hours.

Prophylactic antibiotics or antithrombotics were not routinely administered. Thirteen (87 %) operations were performed under spinal and two under general anesthesia.

Transanal rectoceleplasty (study V)

Patients were given a cleansing enema prior to the operation. During the operative procedure the patient was placed in jackknife position and a vaginal pack was used to note any incidental suture perforation of the vaginal mucosa. A Parks anal retractor was introduced with a maximum opening of 4 cm. Local anesthetic with epinephrine (1:200000) (Lidocain c. adrenalin®, Orion oyj, Espoo, Finland) was injected submucosally to facilitate dissection. A

mucomuscular flap with a broader base was created: a transverse incision was made at the dentate line, followed by two vertical incisions beginning at either end of the transverse incision, which extended approximately seven cm. Four vertical and two horizontal sutures with absorbable polyglycolic acid sutures (#2-0 Vicryl®; Johnson & Johnson, Brussels, Belgium) were placed without penetrating the vaginal mucosa and all sutures tied. Excess mucomuscular flap was excised and closed with a running suture (#3-0 Vicryl®; Johnson & Johnson, Brussels, Belgium). The vaginal pack was removed and a hemostatic sponge was left in the anal canal and removed on the first postoperative day.

Prophylactic antibiotics or antithrombotics were not routinely given. Nine (67 %) operations were performed under spinal and six under general anesthesia.

Statistics

Continuous normally distributed data were described by their means, range and standard deviation. Data with skewed distribution were described by their median and range. The significance of differences between the groups was determined using Student's t-test or Mann-Whitney U test or the χ^2 or Fisher's exact test for nominal or ordinal data. The significance of differences between the preoperative and follow-up examinations in study V was tested by paired samples t-test and by Wilcoxon signed rank test.

A logistic regression model was used to identify risk factors and to control for potential confounding factors by forward (Study IV) or backward (study I) step-wise methods. Factors associated with infectious complications after SSLF were also tested by univariate analysis in study I.

Kaplan-Meier estimates of time until failure of surgery were used in studies I and IV and differences in recurrence-free periods between the groups in study IV were tested by log rank test. Cox regression analysis by backward step-wise method was used to identify risk factors for recurrence after SSLF in study I.

Statistical analyses were performed with SPSS 7.5 for Windows (SPSS Inc., Chicago, IL) software package. P-values <0.05 and 95 % confidence intervals were considered statistically significant.

Ethical considerations

The Ethics Committee of Tampere University Hospital approved the study protocols. Informed consent was obtained from each patient.

RESULTS

Preoperative evaluation

Symptoms

All 194 cases reported in the original publications were symptomatic. The main complaints of the patients treated for uterine procidentia or vagina vault prolapse (studies I-IV) were vaginal bulge (67 %) and voiding difficulties (31 %).

All patients in study V reported incomplete evacuation of the rectum and 70 % reported a need to digitally assist rectal emptying as well as pelvic heaviness. The defecation diary revealed that seven (23 %) patients had symptoms of anal incontinence. Twenty-three (77 %) patients were sexually active and six of them reported dyspareunia due to rectocele. There were no differences between the study groups.

Status

The preoperative statuses of the patients in the original studies are set out in Table 6. The main indication for operation for the four patients with grade 1 prolapse was posthysterectomy enterocele.

Table 6. *Preoperative status of patients in the original publications.*

Study	Proportion (%) of patients				Point Ap (mean±sd)
	Grade 1	Grade 2	Grade 3	Grade 4	
I	4	25	25	46	
II	0	0	24	76	
III					
SSLF	0	27	23	50	
SSLF + VH	0	17	27	57	
IV					
SSLF	0	35	23	42	
ASC	0	15	42	42	
V					
TV		100*			-0.10±0.74
TA		100*			-0.03±0.67

*All patients had stage II posterior vaginal vault prolapse according to the classification recommended by ICS (Bump et al. 1996)

TV=transvaginal posterior colporrhaphy

TA=transanal rectoceleplasty

Other preoperative evaluation (study V)

The mean depth of rectocele in defecography in the thirty women undergoing rectocele repair was 5.8±1.7 (3.0-8.5) cm; no differences were noted between the groups. Twenty-seven (90 %) patients evinced normal colon transit. Anorectal manometry was normal in all cases and no differences were noted between the study groups.

Surgery

Additional operations

Forty-seven (34 %) patients underwent concomitant VH; anterior colporrhaphy was performed in 116 (84 %) and posterior colporrhaphy in 103 (75 %) cases. Only one patient underwent SSLF without concomitant anterior or posterior repair.

One (4 %) patient underwent concomitant anterior colporrhaphy and two (8 %) posterior colporrhaphy concomitantly with ASC (study IV).

Patients undergoing rectocele repair (study V) had no other concurrent surgery with the exception that two patients in the vaginal group underwent repair of enterocele.

Complications

Sacrospinous ligament fixation (Studies I-IV)

The median blood loss during SSLF and pelvic floor reconstruction was 300 (20-1300) ml and 20 % of patients suffered blood loss ≥ 600 ml. Two cystotomies and one enterotomy occurred. Eleven (8 %) patients had voiding dysfunction for longer than two days. Seven (5 %) patients had severe cardiopulmonary complications, one died of pulmonary embolism. Fifteen (11 %) patients were diagnosed with postoperative vaginal cuff infection and 48 (35 %) with urinary tract infection. Four (3 %) patients experienced buttock pain but this was relieved within four weeks in all cases.

None of the patients receiving intravenous antibiotic prophylaxis suffered vaginal cuff infection. For further analysis postoperative vaginal cuff infection and urinary tract infection were combined as postoperative infection. Factors associated with postoperative infection were tested by both univariate analysis and logistic regression. Lack of intravenous antibiotic prophylaxis, presence of vaginal ulcerations and age less than 73 years reached significance in both of these analyses.

Four out of seven severe cardiovascular complications occurred in women of advanced age, ≥ 80 years (study II). All had a history of coronary heart disease. Those receiving antithrombotic prophylaxis had greater blood loss than those not receiving, but the difference was not statistically significant.

No statistically significant changes were noted when subgroups with or without concomitant vaginal hysterectomy were compared (study III). The mean operative time was 21 minutes longer ($p < 0.05$) in cases with concomitant VH. The mean blood loss was greater for the subgroup of combined operation, but the difference did not reach statistical significance.

Abdominal sacral colpopexy (study IV)

The mean blood loss here was 100 ± 60 ml, statistically significantly less than with patients undergoing vaginal surgery (290 ± 160 ml, $p < 0.001$). Five (19 %) patients had urinary tract infection, three (12 %) wound infection and one

postoperative hematoma. Other complications included one wound dehiscence requiring resuturation and one postoperative ileus not requiring reoperation.

Rectocele repair (study V)

Blood loss was statistically significantly greater in the subgroup of vaginal surgery, being 120 ± 90 versus 60 ± 40 ml in the transanal group ($p=0.03$). None of the patients required blood transfusions. Major complications were infrequent. One patient in the transanal group had postoperative infection and another had anaphylactic reaction after spinal block. Both were treated with medication and recovered.

Long-term outcomes

Recurrence rates

Sacrospinous ligament fixation (studies I-IV)

Twenty-one percent of the 122 patients followed were diagnosed with recurrence, eight per cent had symptomatic recurrence, and five per cent needed subsequent surgical treatment. Cystocele was the most frequent recurrence with an 11 % incidence (14 patients). Three of the cystoceles were symptomatic, one was subsequently reoperated and four were *de novo*, with no anterior colporrhaphy during SSLF. Six vaginal vault prolapses were detected, all symptomatic; four of them were reoperated. The recurrence rate for enterocele was three and for rectocele two per cent.

Seventy-six per cent of recurrences were diagnosed within 24 months of surgery and all vault prolapses within 48 months of surgery. The recurrence-free survival rates at 1, 2, 5 and 10 years were 92 %, 86 %, 73 % and 67 %, respectively. The duration of recurrence-free period is shown in Fig. 5.

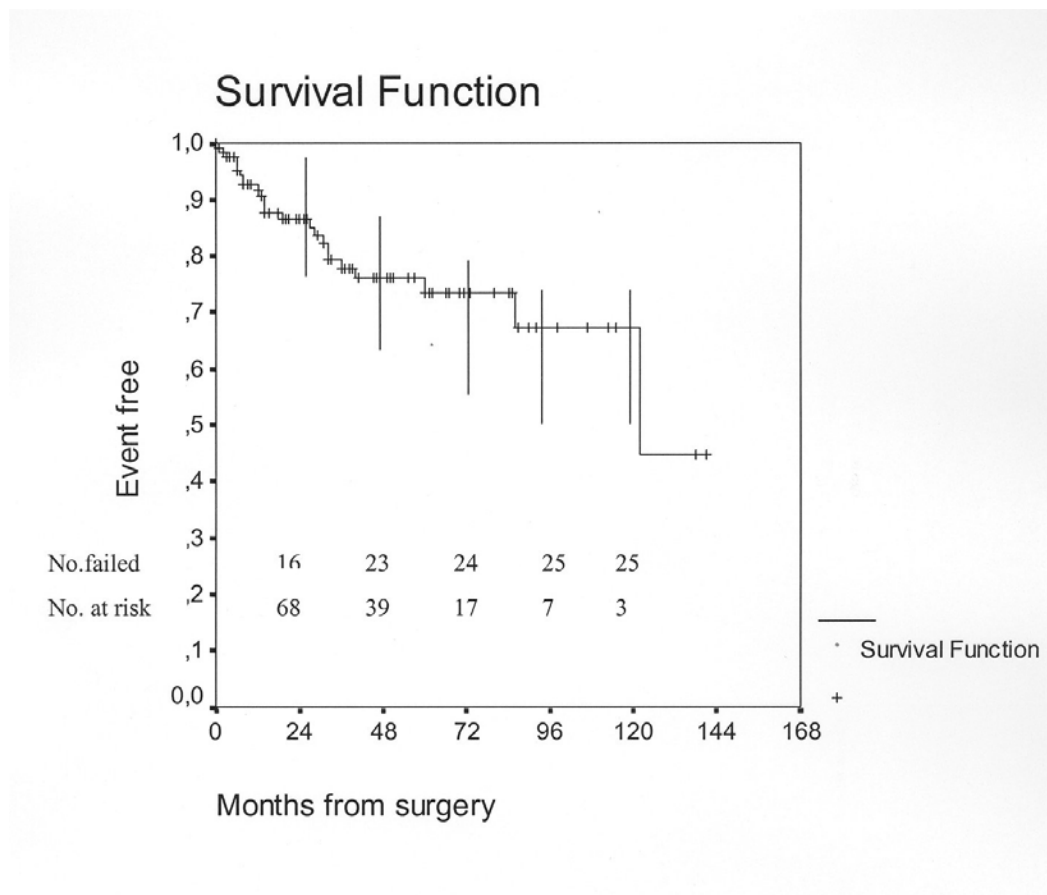


Figure 5. *Survival analysis of recurrence at any vaginal site during the follow-up period. A Kaplan-Meier curve is illustrated. Reproduced with permission of Blackwell Publishing Ltd, from Nieminen K, Huhtala H and Heinonen PK (2003): Anatomic and functional assessment and risk factors of recurrent prolapse after vaginal sacrospinous fixation. Acta Obstet Gynecol Scand 82:471-478.*

Abdominal sacral colpopexy (study IV)

Twelve patients (46 %) out of 26 were diagnosed with recurrence at some site, which was statistically significantly more often than with patients undergoing SSLF ($p=0.001$). The recurrences at given sites were seven cystoceles, six rectoceles, four enteroceles and three vaginal vault prolapses. In survival analysis, the difference between the groups was statistically significant ($p=0.01$, Fig. 6).

Logistic regression showed that patients undergoing abdominal surgery ran a 6.0 (95 % CI 1.5-24) times greater risk of recurrence than patients undergoing vaginal surgery. No other factors reached significance.

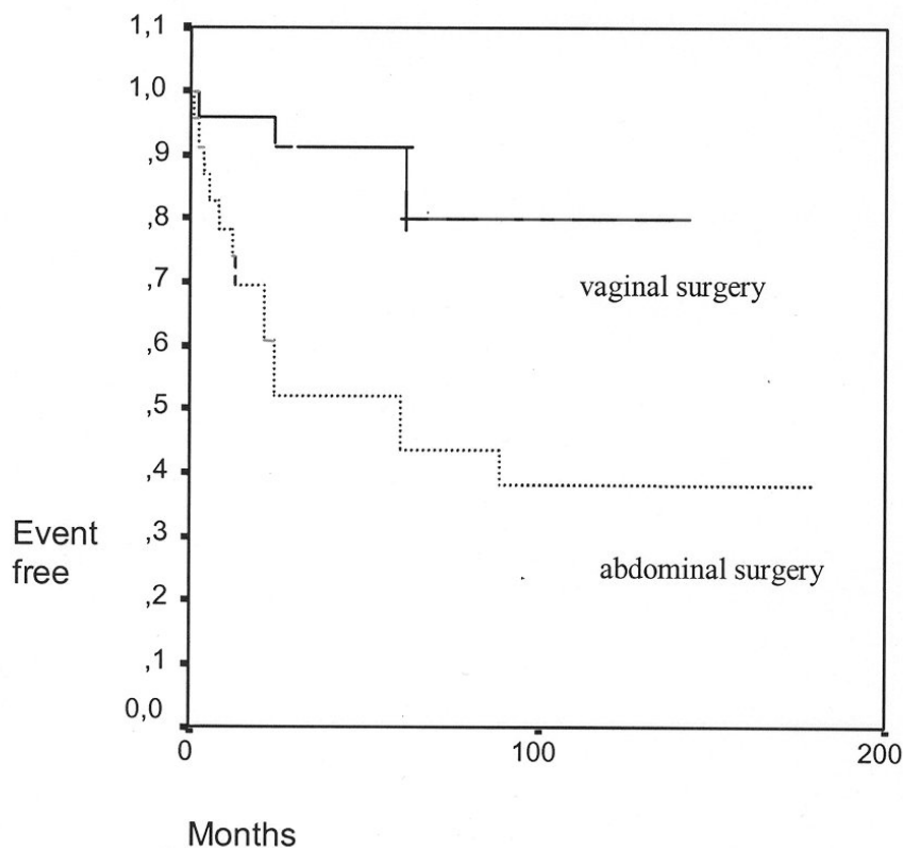


Figure 6. Kaplan-Meier curves of recurrence-free periods with vaginal or abdominal approach. The difference between the curves is statistically significant ($p=0.01$).

Reproduced with permission of Lippincot Williams & Wilkins Inc from Nieminen K and Heinonen PK (2000): Long-term outcome of abdominal sacral colpopexy or vaginal sacrospinous ligament fixation for posthysterectomy vaginal vault prolapse. *J Pelvic Surg* 6:254-260

Rectocele repair (study V)

Fourteen patients (93 %) undergoing vaginal and eleven (73 %) undergoing transanal surgery reported improvement of rectocele-related symptoms ($p=0.08$ between the study groups). In both groups, the need to digitally assist rectal emptying was statistically significantly alleviated.

Clinically diagnosed posterior vaginal wall prolapse was detected in one (7 %) patient after vaginal and in 10 (67 %) after transanal repair ($p=0.01$). The recurrence in the subgroup of vaginal surgery was rectocele, whereas the 10

recurrences after transanal surgery were four rectoceles, four enteroceles and 2 rectoenteroceles. The recurrent rectocele rates for vaginal and transanal subgroups were 7 % and 40 %, respectively (p=0.04).

In both groups the mean values of point Ap were significantly reduced closer to the normal value of -3. However, the values of point Ap 12 months after surgery were statistically significantly better after vaginal than transanal surgery, being -2.8 versus -1.36 (p=0.01), respectively.

In defecography, the mean depth of rectocele was statistically significantly reduced after vaginal surgery (6.0 versus 2.7 cm p<0.0001) but not after transanal surgery (5.6 versus 4.12, p=0.07). However, the difference between the groups at follow-up was not statistically significant.

Risk factors for recurrence after SSLF

Cox regression showed that an inexperienced surgeon, infectious complications, low age and the length of follow-up were risk factors associated with recurrent prolapse (Table 7).

Table 7. *Prognostic factors underlying recurrence of prolapse after SSLF assessed by Cox regression, backward stepwise method.*

Variable	n	OR	95 % CI
Experience of surgeon			
>20 operations	82	ref	
<20 operations	40	2.72	1.08-6.81
Vaginal cuff infection			
no	108	ref	
yes	14	6.13	1.80-20.83
Urinary tract infection			
no	82	ref	
yes	40	3.65	1.40-9.47
Length of follow-up (months)		1.07	1.03-1.10
Age (years) at the operation			
>76	39	ref	
70-75	35	3.23	0.77-14.3
<70	48	4.3	1.27-14.3

Reproduced with permission of Blackwell Publishing Ltd from Nieminen K, Huhtala H and Heinonen PK (2003): Anatomic and functional assessment and risk factors of recurrent prolapse after vaginal sacrospinous fixation. Acta Obstet Gynecol Scand 82:471-478.

Sexual function

Sacrospinous ligament fixation (studies I-IV)

A total of 103 patients answered questions concerning sexual life and activity. Seventy reported sexual inactivity. The results of the inquiry are summarized in Table 8.

Table 8. *The effect of operation on sexual activity and causes of inactivity in 103 patients.*

Sexual function	n	%			
Active	33	32	<u>effect of operation</u>	n	%
			no change	19	58
			improved	11	33
			adverse	3	9
Inactive	70	68	<u>cause of inactivity</u>		
			no partner	52	74
			partner's disability	13	19
			disinterest	5	7

Reproduced with permission of Blackwell Publishing Ltd, from Nieminen K, Huhtala H and Heinonen PK (2003): Anatomic and functional assessment and risk factors of recurrent prolapse after vaginal sacrospinous fixation. Acta Obstet Gynecol Scand 82:471-478.

The mean total vaginal length for the whole study group but also for sexually active or inactive patients was 9.5 ± 2 cm. Nine patients were found to have a narrowed vagina; one of them reported being sexually active. The mean age of the sexually inactive patients versus active patients was 74 ± 7 versus 61 ± 9 years, respectively ($p=0.02$).

Abdominal sacral colpopexy (study IV)

Four women in the abdominal group reported improvement of sexual function postoperatively, one reported new-onset dyspareunia and one reported new-onset dyspareunia so severe that it caused sexual inactivity. No differences were noted between the groups, none of the patients who underwent SSLF reported that the operation had induced sexual inactivity. The mean total vaginal length for abdominal and vaginal groups was 11.4 ± 1.4 versus 9.3 ± 2.7 cm ($p=0.08$), respectively.

Rectocele repair (study V)

At follow-up a total of 21 women, 11 in the vaginal and 10 in the transanal group, reported being sexually active. The mean monthly coital frequencies did not differ between the groups, being 2.9 and 2.5, respectively. None of the women attending the study reported *de novo* dyspareunia, while one patient in the transanal group suffered recurrent dyspareunia due to recurring rectocele. Six women in the vaginal and two in the transanal group reported improvement of sexual function. None of the patients had narrowed vagina upon examination nor reported any adverse effects of the operation in respect of sexual function.

Adverse effects of surgery

Sacrospinous ligament fixation (studies I-IV)

Thirteen (11 %) out of 122 patients reported urinary symptoms at follow-up. Seven patients reported *de novo* stress incontinence symptoms and six urgency or urge incontinence. No treatment was needed for these symptoms. None of the patients reported fecal incontinence. Fourteen patients (11 %) reported some difficulties in defecation. Eleven (9 %) patients reported expressed dissatisfaction with the operation.

Abdominal sacral colpopexy (study IV)

Four (15 %) out of 26 patients had been operated on for incisional hernia. Three (15 %) of the 20 patients attending follow-up reported symptoms of stress urinary incontinence and one of urgency. Five (25 %) patients reported difficulties in defecation. Four (20 %) patients were dissatisfied with the results of the operation; however, none of them suffered recurrent prolapse.

Anal continence after rectocele repair (study V)

At follow-up anorectal manometry the MARP and MASP values did not differ significantly between the groups, but the mean MARP values statistically significantly deteriorated in the transanal group, being 55.3 ± 12.5 mmHg preoperatively and 51.2 ± 15.4 mmHg at follow-up ($p=0.045$). However, none of the patients reported incontinence of liquid or solid stool. The frequency of gas incontinence for the vaginal or transanal groups was zero versus four, respectively ($p=0.06$).

DISCUSSION

Treatment of massive genital prolapse is a challenging undertaking. The goals of reconstructive surgery are permanent relief of symptoms, restoration of anatomy and maintenance of vaginal capacity for sexual function in sexually active patients without adverse effects of surgery. An ageing female population with increased life expectancy in many countries means that in the future we will face this problem increasingly frequently and also with patients in their 80s or even 90s.

SSLF has many advantages. As a vaginal procedure it can be performed under regional anesthesia, laparotomy is avoided and it facilitates concurrent pelvic floor repair, which is mandatory in relieving the patient's symptoms. One of the main concerns after SSLF has been a high incidence of cystocele, albeit with great variation in incidence. In contrast, Smilen and associates (1998) reported that cystocele formation after anterior repair was not less frequent without concomitant SSLF.

Vaginal posterior colporrhaphy has been used for a century, whereas the transanal technique was evolved by coloproctologists in the 1980s. Comparison of results of these techniques is difficult because different outcomes are reported and prospective randomized studies are lacking. The main concern after the vaginal technique has been dyspareunia (Kahn and Stanton 1998), whereas transanal technique may compromise anal sphincter function (Ho et al. 1998).

In the present study, the retrospective design was chosen as being the only method to collect data on a sufficient body of patients; these 138 patients were operated during a fourteen-year period. Two different staging systems had to be used, because the POP-Q system could not be used when assessing preoperative status from the hospital charts. The retrospective nature of the studies is a limitation. On the other hand, follow-up data were available on 88 % of the patients, and the results of the pelvic examination were reported by the POP-Q system.

Matching of the patients in study III was successful. There were no differences between the groups regarding important patient characteristics, which justifies our conclusions.

Study IV, comparing SSLF and ASC, was also retrospective. After SSLF became popular ASC has been used only in anecdotal cases. The difference between the follow-up periods may have affected our results, but this was controlled for by the use of survival analysis.

Study V was a prospective randomized trial. The sample size, 15 patients in both groups, was relatively small, but statistical differences in outcomes were

reached between the groups. Power calculation was not undertaken, because we estimated that patients with solitary rectocele and intact anal sphincter function are rare. After 30 patients recruitment was discontinued, as the process took over three years. Patient assessment in this study was adequate including interview, clinical examination, radiological studies and anorectal manometry.

Short-term outcomes of surgery

Sacrospinous ligament fixation

Intraoperative blood loss (median 300 ml) in the present study was comparable with that previously reported, with mean or median values ranging from 225 to 585 ml (Hardiman and Drutz 1996, Colombo and Milani 1998, Meschia et al. 1999, Lantzsich et al. 2001, Lovatsis and Drutz 2002). In contrast, 16 % received blood transfusions, which is more frequently than reported by others and reflects the liberal use of blood transfusions in Finland. In a review article, Sze and Karram (1997) reported that 2 % of patients had received blood transfusion and others have reported frequencies from 0.5 to 8 % (Table 2).

The mortality among our patients was 0.7 % (one patient due to pulmonary embolism), whereas in analyses of mortality reported by others it was 0.2 %. The rate of cardiovascular complications here was 5 % while in the literature it has varied from 0 to 4 %; the majority of studies have not in fact addressed this point (Table 2). Four out of a total of seven cardiovascular complications took place in a subgroup of women aged 80 years or more. All four had coronary heart disease or arterial hypertension, which are known risk factors for cardiovascular morbidity (Shackelford et al. 1995). Operative morbidity and mortality increase with age, but are affected more by comorbid conditions and functional status than by age itself (Miller 1997), which is in accordance with our finding that patients without a history of vascular diseases did well after surgery. Control of hemostasis is imperative in that excess bleeding may stress a weakened myocardium in patients suffering from coronary heart disease or arterial hypertension (Shackelford et al. 1995, DeLancey and Morley 1997). Also blood transfusions should be given when indicated. Early mobilisation and hospital discharge may be factors influencing the rate of thromboembolic complications. However, the shorter hospital stay had no influence on the frequency of such complications.

Antithrombotic prophylaxis was used in only 29 % of patients. In the early years of the study prophylaxis was seldom used, whereas nowadays it is routine being recommended as such especially for older patients (Miller 1997). Routine use of thrombosis prophylaxis might have reduced the incidence of cardiovascular events, although our patient who died of pulmonary embolism

had prophylaxis. On the other hand, antithrombotic prophylaxis may have a role in increasing intraoperative blood loss.

Obliterative procedures such as colpocleisis or the Neugebauer-LeFort operation have been recommended for poor operative candidates. However, a 5 to 16 % incidence of cardiovascular complications and mortality up to 5 %, have been reported (Hanson and Keettel 1969, Ahranjani et al. 1992, Denehy et al. 1995, DeLancey and Morley 1997). Additionally, no reconstructive procedures can be performed, coital function will be lost, diagnosis of uterine malignancy is rendered difficult and these measures carry a risk of *de novo* urinary incontinence (Cundiff and Addison 1998, Tooze-Hobson 1998). There are no comparative studies, but it seems that obliterative procedures have no advantage in reducing postoperative morbidity when compared to SSLF.

Cysto- and enterotomies occurred infrequently, as has been the case in previous surveys. Concomitant vaginal hysterectomy did not affect the complication rate. Lengthier operation, on average by 21 minutes, cannot be regarded as a complication. Urinary symptoms reported by 11 % of patients at follow-up were mild and required no treatment and may reflect rather the advancing age of the patients than adverse effects of SSLF.

The rate of postoperative vaginal cuff infection in published papers has varied from 0.3 to 18 % (Table 2); in the present study it was 11 %. These figures are difficult to compare because neither definition nor severity of postoperative infection is given. Febrile morbidity has also been used as a marker of postoperative infection despite its limited value (Shackelford et al. 1999). Hoffman and colleagues (1996) with an 18 % and Lovatsis and Drutz (2002) with a 0.3 % incidence both used intravenous prophylaxis, whereas in the present study only 26 % received intravenous prophylaxis. Here, none of the patients with prophylaxis suffered vaginal cuff infection, which would witness the importance of prophylaxis. The high incidence of vaginal cuff infection reported by Hoffman and associates (1996) might be due to difference in definitions, not indicating poor efficacy of prophylaxis.

No intravenous antibiotic prophylaxis, vaginal ulcerations and younger age were risk factors for postoperative infectious complications in univariate analysis and logistic regression. Intravenous antibiotic prophylaxis and treatment of ulcerations preoperatively is imperative in avoiding postoperative infections, although topical estrogen treatment is challenging in patients with advanced genital prolapse. The role of younger age as a risk factor for infectious complications is somewhat confusing, but may be attributable to a more virulent bacterial flora (Hager 1997).

Buttock pain as a marker of nerve damage was seen in only three per cent of the patients and was relieved within four weeks without specific treatment. Some authors have reported higher frequencies (Table 2) and even permanent foot drop (Monk et al. 1991). The most important factor in avoiding permanent nerve damage as well as massive bleeding is knowledge of anatomy of the sacrospinous ligament and adjacent structures.

Abdominal sacral colpopexy

In the present study (IV) the blood loss was significantly smaller in patients undergoing abdominal as against vaginal procedure. This merely reflects the amount of concomitant pelvic floor repair rather than a difference in blood loss in the fixation procedure. Massive hemorrhage, a life-threatening complication infrequently reported by others, was avoided and generally blood loss here was less than reported elsewhere (Timmons et al. 1992, Benson et al. 1996, Hardiman and Drutz 1996). Other complications included anecdotal wound infections, hematoma, dehiscence and ileus, which are also reported by others (Timmons et al. 1992, Benson et al. 1996, Hardiman and Drutz 1996), but are practically never seen after vaginal procedures. Of note are the four incisional hernias requiring treatment as long-term complications.

Rectocele repair

The greater blood loss attending the vaginal technique is of limited clinical value, in view of the relatively small amount of bleeding not requiring transfusions. Major complications such as wound dehiscence, pelvic sepsis or rectovaginal fistulas, which are infrequently reported by others especially after the transanal technique, did not take place (Murthy et al. 1996, Khubchandani et al. 1997, Boccasanta et al. 2001).

Long-term outcomes

Sacrospinous ligament fixation

The cure rate in the present study was 79 %, whereas in the literature it has varied from 67-90 % (Table 1). Cystocele incidence was 11 % when in the literature it has varied from 0 to 92 %. Sze and Karram (1997) summarized outcomes of 1062 patients undergoing SSLF and reported an 8 % incidence of cystocele. In the same review they reported that nine per cent of anterior wall recurrences required reoperation. The percentage of symptomatic cystoceles was not reported in that meta-analysis. Holley and group (1995) reported the often cited 92 % incidence of cystocele after SSLF. However, their grading was different than POP-Q and 76 % of cystoceles protruded only to the hymen or less, making comparisons to recent studies difficult. Another point is that 72 %

of those recurrences were asymptomatic, thus requiring no treatment. The reoperation rate was not reported. In the present study the incidence of symptomatic cystocele was 2.5 % and of cases requiring reoperation 0.8 %.

Retroversion of the vagina leading to an unprotected anterior vaginal wall has been suggested to predispose to cystocele formation (Porges and Smilen 1994, Cundiff and Addison 1998). A group under Smilen (1998) reported that concomitant SSLF with anterior repair did not affect the incidence of recurrent cystocele. They suggested maintenance of anterior wall length during SSLF to be an important technical point in avoiding anterior wall recurrence. Shull and associates (1992) emphasized identification and repair of all anatomic defects, especially in the anterior vaginal wall.

The incidence of recurrent vault prolapse here was 5 %, that in published studies being 4 % (125 recurrences in 2883 patients, Table 1), ranging from 0 (Heinonen 1992) to 21 % (Sauer and Klutke 1995). All vault recurrences in the present study were symptomatic and four out of six were reoperated. One of the patients in question has undergone three repeated fixations, both abdominal and vaginal, indicating how challenging the treatment of surgical failure can be. The overall reoperation rate was five per cent, while Sze and Karram reported three per cent in their review.

Sixty-two per cent of recurrences, mainly apical and posterior, took place within two years from surgery, whereas anterior recurrences were diagnosed throughout the follow-up period. This may indicate the importance of perioperative factors such as complications and surgical technique. Meschia and associates (1999) noted a similar pattern with recurrent vault prolapse but also with anterior recurrence, whereas in the study by a group under Paraiso (1996) recurrences were distributed more evenly.

To date, only Paraiso and associates (1996) have reported survival analysis of recurrence. Their recurrence-free rates at 1, 5 and 10 years were 88.3 %, 79.7 % and 51.9 % while the figures in the present study were 92 %, 73 % and 67 %, respectively.

Postoperative vaginal cuff infection caused a sixfold risk of recurrence, which is a new finding. The mechanism underlying this may be suture displacement and weakening of vaginal tissues. Urinary tract infection as a risk factor is less easy to understand. Perhaps some of the patients with bacteruria actually suffered from cuff infection which was not diagnosed. This is the reason for including urinary tract infections among infectious complications when risk factors were assessed.

Other risk factors were length of follow-up, inexperienced surgeon and younger age. Inherited weakness of tissues is regarded as one of the etiologic factors underlying POP (Nichols 1992, Norton et al. 1995). This would explain the poorer prognosis of surgery with the youngest third of the patients.

Abdominal sacral colpopexy

In this study both ASC and SSLF obtained good long-term results in the treatment of vault prolapse. Three failures in the abdominal group and none in the vaginal group were noted, without statistical significance. However, when all recurrences at any site were taken into account, the vaginal approach reached significantly better outcomes in proportions and survival analysis. This difference merely reflects the difference in pelvic floor and enterocele repair rates rather than the operative techniques themselves. Morley and DeLancey (1988) stated that two thirds of vaginal eversions are accompanied by cysto- or rectocele and Morley (1993) that enterocele is present in 90 % of cases, indicating the importance pelvic floor and enterocele repair.

Our results were markedly different from those obtained by Benson associates (1996). The study in question has been criticized (Koduri and Sand 2000) in that results of both approaches were poor: optimal outcome was obtained with 29 % of the patients in the vaginal and 58 % in the abdominal group. The sacrospinous fixation was performed bilaterally, 50 % of patients underwent concomitant hysterectomy and 52 % anti-incontinence procedure. Another study by Hardiman and Drutz (1996) involved 125 patients in the vaginal and 80 in the abdominal group and no difference was noted in the vault recurrence rate; other forms of recurrence were not reported.

Rectocele repair

The point Ap values after surgery were closer to normal in the vaginal group and the rate of clinical posterior vaginal wall prolapse recurrences surprisingly high after transanal rectoceleplasty, 67 % versus 7 % in the vaginal group. After posterior colporrhaphy, rates of clinical recurrences have varied from 4 % to 30 % (Mellgren et al. 1995, Infantino et al. 1995, Kahn and Stanton 1997, Paraiso et al. 2001, Sloots et al. 2003). In contrast, papers dealing with the transanal technique rarely report rates of clinically diagnosed recurrent rectoceles. Murthy and colleagues (1996) reported 80 % anatomical cure of 33 patients and Tjandra and group (1999) 76 % in 59 patients. However, in these studies preoperatively a vaginal bulge was noted in 61 % and 88 % of patients, respectively. Additionally, criteria for recurrence and the method of clinical examination are rarely described, making comparisons difficult.

A high frequency of enterocele after transanal surgery has not previously been reported. Cases with enterocele were excluded from this study, but in two women undergoing vaginal operation it was noted intraoperatively, indicating the difficulty of diagnosing occult enterocele. One explanation may be that transanal surgery predisposes to enterocele formation.

Symptoms related to bowel function improved significantly in both groups and no differences were noted between the groups at follow-up. Symptom improvement rates were similar to those reported elsewhere (Arnold et al. 1990,

Mellgren et al. 1995, Karlbom et al. 1996, Khubchandani et al. 1997, Ho et al. 1998, Paraiso et al. 2001, Sloots et al. 2003). In the present study, anatomical cure and symptom improvement were not in accordance with each other, probably due to the fact that a considerable proportion of patients with rectocele are asymptomatic (Brubaker 1996, Murthy et al. 1996).

Defecography at follow-up showed a tendency towards lesser depth of rectocele in the vaginal group, although the difference was not significant. The mean depth of rectocele was statistically significantly diminished after vaginal but not after transanal surgery. This would support the findings in the clinical examination.

Better results after vaginal technique may be due to technical aspects. This approach facilitates opening of the posterior vagina wall up to the posterior fornix of the vaginal apex, the point usually not reached by transanal approach. Dissection of the proximal vaginal wall also gives an opportunity to diagnose and treat occult enterocele and to prevent subsequent enterocele. More extensive dissection and closure of connective tissue under better visual control facilitate more meticulous repair by the vaginal technique.

Ho and associates (1998) suggested that transanal approach could adversely effect anal sphincter function and results of van Dam and colleagues (2000) support this view. The problem is thought to be due to the use of anal retractor. Our results support the findings of Ho's group (1998). Patients with signs of compromised anal sphincter function were excluded from the study and deterioration of MARP values was seen in patients undergoing transanal surgery. However, no statistically significant difference in anal incontinence rates was detected between the groups.

Sexual function

Adverse effects on sexual function were rare in this study, only nine per cent of sexually active patients reporting adverse effect as against 33 % noting improvement after SSLF. Shortening or narrowing of the vagina was not a problem. The mean length of the vagina here was 9.5 cm, when in previous studies it has varied from 8.0 to 8.3 cm (Given et al. 1993, Elkins et al. 1995, Paraiso et al. 1996). Nine per cent had narrowed vagina; others have reported a 17 % incidence. It seems that libido, age and lack of partner are more important factors affecting sexual activity than sacrospinous fixation itself.

In study IV, ASC was not superior to SSLF in preserving coital function, as was also reported by Hardiman and Drutz (1996) in their paper comparing these procedures. Additionally, Virtanen and colleagues (1994) noted a 22 % rate of increased dyspareunia after abdominal operation. Actually, the only patient in this study reporting that sequelae of operation prevented intercourse had undergone ASC. In contrast, Benson and associates (1996) had different

outcomes, 58 % of sexually active patients reporting dyspareunia after bilateral SSLF and none after ASC.

One of the main concerns following posterior colporrhaphy has been sexual dysfunction, especially dyspareunia. Kahn and Stanton (1997) reported a rise in “sexual dysfunction” from 18 to 27 % and this has also been reported by others (Mellgren et al. 1995, López et al. 2001, Paraiso 2001). In contrast, a group under Infantino (1995) found no patients suffering from dyspareunia postoperatively and Sloots and colleagues (2003) noted that the dyspareunia rate remained unchanged. Papers dealing with transanal technique have not dealt with this matter, except for Arnold and group (1990) who surprisingly reported similar dyspareunia rates after vaginal or transanal surgery. In the present study, levator stitches were not used and special attention was paid to avoiding vaginal tightening in order not to cause dyspareunia. We had no cases of de novo dyspareunia or complaints of adverse effects of surgery and 27 % reported improvement. Posterior colporrhaphy without suturing of the levator muscles seems to be as well tolerated as the transanal approach.

Future prospects

SSLF with pelvic floor reconstruction is an efficient and well-documented means of correcting uterine procidentia and vaginal vault prolapse. Recurrent cystocele is a problem, although most cases are asymptomatic, not requiring treatment. Prophylaxis with synthetic mesh in the anterior vagina is an interesting option and calls for further studies. Infection prophylaxis, operative techniques and experience of the surgeons are important factors in achieving good long-term results.

Posterior IVS is an interesting operation, which has the same indications as SSLF. Theoretically, vaginal suspension with synthetic tape creating an artificial neoligament offers the possibility to maintain the physiological vaginal axis and permanent cure. However, its long-term efficacy is yet to be proven and concern regarding rejection of the tape prevails.

Abdominal sacral colpopexy is an effective method for the treatment of vault prolapse. When performed laparoscopically, the laparotomy wound can be avoided, but general anesthesia is still a risk for elderly patients. Especially for patients with adnexal pathology or vagina too short to be fixated transvaginally it is an option. However, the laparoscopic approach has not been extensively studied and data on long-term outcomes or comparisons to other methods are lacking. The role of laparoscopic surgery in the treatment of genital prolapse remains to be seen.

Vaginal posterior colporrhaphy is an effective method for correcting symptomatic rectocele without major adverse effects. Transanal rectoceleplasty seems to be less effective but is suitable for patients with other forms of anorectal pathology, which can be treated concomitantly. Defect-specific

rectocele repair is an option, which seems to be appropriate. However, it should be compared with traditional posterior colporrhaphy in a prospective, randomized trial. For recurrent rectocele application of synthetic mesh is an option which calls for further studies to assess its efficacy and side-effects.

CONCLUSIONS AND SUMMARY

Conclusions

1. SSLF with pelvic floor repair is an effective means of correcting both massive posthysterectomy vaginal vault prolapse and uterine procidentia. Postoperative infections, inexperienced surgeon and patient's low age are risk factors of recurrence. Intravenous prophylactic antibiotics are imperative in avoiding infections. SSLF is also suitable for women who wish to preserve coital function.
2. Aged women with massive uterovaginal or vault prolapse can be effectively treated by SSLF under regional anesthesia. Elderly patients with no history of vascular diseases can be treated by this operation as can younger ones. Intraoperative bleeding control seems to be an important point especially with high-risk patients.
3. Vaginal hysterectomy can be performed concomitantly with SSLF when indicated without extra complications.
4. ASC and SSLF are effective means of correcting posthysterectomy vaginal vault prolapse. Pelvic floor relaxation should be sought preoperatively and repaired, especially when the abdominal approach is chosen. Repair of enterocele is of great importance in obtaining good long-term results.
5. Posterior colporrhaphy and transanal rectocele repair are effective in alleviating patients' symptoms. The risk of dyspareunia can be avoided with both approaches. The transanal technique is associated more often with posterior vaginal wall recurrences, which, however, are often asymptomatic.

Summary

This thesis was undertaken to evaluate short-term and long-term outcomes of SSLF for treatment of uterine procidentia and vaginal vault prolapse, to compare its outcomes with those of ASC and to compare the transanal and vaginal approaches for rectocele repair.

The cure rate after SSLF was 79 %; 11 % of 122 patients with follow-up information were diagnosed with cystocele and eight per cent had symptomatic recurrence. Postoperative vaginal cuff and urinary tract infections, inexperienced surgeon, low age at operation and length of follow-up were independent risk factors of recurrence. Patients with no antibiotic prophylaxis, preoperative vaginal ulcerations and age less than 73 years were at elevated risk of infectious complications. Maintenance of vaginal capacity for sexual function was possible.

Twenty-five women were 80 years old or older at the time of SSLF. Sixteen per cent of the patients, all with a history of coronary heart disease, had cardiovascular complications; one died of pulmonary embolism. Additionally, the amount of blood loss may be an important factor increasing the risk of cardiovascular complications. No subsequent surgery was required; the rate of symptomatic recurrence was five per cent.

Short-term outcomes of SSLF and pelvic floor repair were similar for subgroups of posthysterectomy vaginal vault prolapse and severe uterine prolapse with concomitant vaginal hysterectomy. On the average, operative time was 21 minutes longer in the case of patients undergoing vaginal hysterectomy.

ASC and SSLF proved equally effective for the treatment of posthysterectomy vaginal vault prolapse when cure of apical defects was assessed. However, the overall recurrence rate was higher after ASC. The difference is probably due to more frequent repair of pelvic floor relaxation and enterocele concomitantly with SSLF. No differences were noted between the operative approaches in preserving coital function.

Bowel symptoms were alleviated by both posterior colporrhaphy and transanal rectocele repair. Clinically diagnosed recurrent posterior vaginal wall prolapse, rectocele or enterocele was noted more frequently after transanal repair. MARP values deteriorated after transanal surgery, but no significant changes were noted in respect of anal incontinence. De novo dyspareunia cases were not noted after either operative approach.

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