An Evaluation of Laparoscopic Pelvic Floor Repair

by

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Dedication

This thesis is gratefully dedicated to those to whom the time spent in preparing it really belonged: my wife Marija, sons Patrick and Jonathan, and my extended family.

Preface

In the preface of the first English monograph on laparoscopy written by Steptoe in 1967, Morris observed that "in the lifetime of physicians and surgeons still engaged in active practice, the techniques of endoscopy have advanced out of all knowledge [1]." He went on to state that "the use of modern endoscopic apparatus for the inspection of the female genital organs offers exciting possibilities in diagnosis, in therapy and in research."

My experience in laparoscopic pelvic floor repair began in 1992. It is largely distilled in this thesis and leads me to conclude that these statements remain as true in 2015 as they were in 1967.

The most exciting advance has been our ability to "see" pelvic floor defects from above with much greater clarity than the vaginal approach, which has tended to be more tactile than visual in its appreciation. We have also observed a shift from a generic vaginal procedure, namely vaginal hysterectomy and repair, to one which is more defect-specific, and uses the optimum mode of access be it vaginal, laparoscopic or both. The last two decades have also seen the application of grafts and meshes to prolapse repair and subsequent complications related directly to the use of these materials. As a consequence, gynaecologists are now seeking alternative techniques of prolapse repair which utilize native tissues and avoid mesh. The theme which runs consistently throughout this thesis is that laparoscopic suture repair has the great virtue of providing a means to deal with most cases of prolapse without recourse to permanent mesh.

1. Steptoe PC. *Laparoscopy in Gynaecology*. London: Livingstone, 1967.

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Summary

Chapter 1 provides a general history of the development of laparoscopy and its application to pelvic floor repair internationally and, more specifically, at Flinders Medical Centre.

Chapter 2 presents a survey of how Australian and New Zealand gynaecologists manage prolapse. Laparoscopic procedures were used by a minority to treat primary and recurrent prolapse in all compartments, and laparoscopic hysteropexy was the procedure of choice when uterine preservation was warranted.

Chapter 3 reports our first two years of experience with laparoscopic prolapse repair in 73 women using native tissue and permanent braided material. Some women had a concurrent transvaginal colporrhaphy. The results showed short term efficacy, both subjective and objective, and compared favourably with other published series of laparoscopic, abdominal and vaginal prolapse repair.

Chapter 4 presents data on 212 women who underwent laparoscopic treatment of cystocoele with paravaginal repair, which was combined with uterosacral suspension for associated apical defects (n=47) and supralevator repair for posterior defects (n=42).. Anterior recurrences were treated by anterior colporrhaphy reinforced by a vaginal skin graft (n=18). This two-stage native tissue approach to the treatment of cystocoele gave an anatomic cure rate (POPQ stage 0 or 1) of 80 percent at an average follow-up of 14.2 months.

Chapter 5 reports on the long-term outcome of laparoscopic paravaginal repair and associated procedures with 106 of 223 women (46 %) followed for more than 5 years.

This study shows that most women with cystocoele can be successfully treated without using permanent mesh.

In **Chapter 6** the focus is the therapeutic challenge of dealing with enterocoele. The technique used in 45 women was a combination of supralevator repair, enterocoele sac excision, uterosacral suspension, and application of vaginal graft in selected patients. Concomitant procedures treated prolapse in adjacent compartments. Eleven percent developed POPQ 2 or greater cystocoele and the overall objective cure for enterocoele at 3 years was 93 percent.

In **Chapter 7**, a decade of experience treating 144 women with laparoscopic supralevator repair is presented. In Australian practice, this procedure has been superseded by laparoscopic mesh sacral colpopexy despite the mesh procedure being technically more demanding and the supralevator repair giving similar anatomic results without the use of permanent mesh and its potentially serious complications.

Chapter 8 addresses the important question of whether uterine preservation versus hysterectomy affects the durability of uterosacral suspension for the treatment of apical defects. Laparoscopic hysterectomy with uterosacral colpopexy, whether performed prophylactically or therapeutically, produced better objective success rates than laparoscopic uterosacral hysteropexy.

Chapter 9 reports on the results of Surgisis-augmented pelvic floor repair in 65 women between 2003 and 2009. The early Surgisis procedures involved the vaginal treatment of cystocoele recurrence after laparoscopic repair and rectocoele recurrence after posterior colporrhaphy. Subsequently, a laparovaginal approach was adopted which combined introduction and distal fixation of the graft vaginally with laparoscopic paravaginal and apical suspension. Ultimately, a completely vaginal

approach was found to be the most time-efficient. The results of Surgisis repair were best for recurrent rectocoele.

Declaration

I certify that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

Elvis I. Seman

CHAPTER 1

The development of laparoscopy and its application to pelvic floor repair

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ABSTRACT

A brief overview is presented of how laparoscopy evolved from a purely diagnostic to a therapeutic procedure. Emphasis is given to the many innovative developments that led to its application to correct pelvic floor dysfunction with its range of anterior, apical and posterior defects. It may serve to reflect on how current methods and techniques can still be improved to deal with pelvic floor defects that are likely to become more prevalent as our population ages.

Introduction

Although attempts to visualize the viscera “per vias naturales” date back to Hippocratic times [1], recorded attempts to do so transabdominally, named ventroscopy by von Ott in 1901, coelioscopy by Kelling in 1902, and laparoscopy by Jacobeus in 1911, only started in the last century [2]. Innovative as these approaches were, it took a great deal of ingenuity from several people to develop the instruments and techniques that have given laparoscopy the diagnostic and therapeutic scope that it has today.

In this paper we briefly mention these early developments before tracing the innovations that led to the use of laparoscopy for the treatment of pelvic organ prolapse, an approach that might seem to be counter-intuitive at first sight.

The eb and flow of early laparoscopy

Much of the early developments in laparoscopy as they relate to gynaecology have been well documented [1-4] and the main innovations made in the first half of the last century are briefly summarized in Table 1. They came somewhat to a standstill in the 1940s, as culdoscopy (endoscopy via the posterior vaginal fornix) surged in popularity, especially in the USA where it found a great advocate in Te Linde [2]. Pelvic organ visualization with the culdoscope was limited, though, until Decker described the knee-shoulder position in 1946 [2].

After World War Two, resurgence in gynaecological laparoscopy was led by Frangenheim in Germany and Palmer in France, from where it spread to the English-speaking world. Its resurgence was facilitated by important innovations. In 1943, Fourestier and colleagues, in Paris, had introduced the cold light source, which overcame the need for and dangers of a hot light bulb at the end of the scope [2]. In

1953, Hopkins introduced the rod lens system which improved visual clarity, the angle of vision, and the depth of field [2]. In the early 1950s, Frangenheim designed laparoscopic instruments and made the first purpose-built CO_2 insufflator [4]. He also popularized tubal cautery, as did Palmer, who wrote extensively on gynaecologic laparoscopy and described the use of the Palmer forceps, which is still in use today. Steptoe wrote the first English monograph on laparoscopy in 1967 [5].

Table 1. Main laparoscopic innovations in the first half of the 20th century [1-4].

Year	Principal innovator	Innovation
1912	Jacobeus	first laparoscopy in humans
1912	Nordentoeft	trocar laparoscope
1924	Zollikofer	CO_2 insuffflator
1933	Fervers	first operative laparocopy (adhesiolysis)
1934	Ruddock	first laparoscopic female sterilisation
1937	Hope	diagnosis of ectopic pregnancy by laparoscopy
1938	Veress	Veress needle
1943	Fourestier	cold light source

Monopolar, bipolar and beyond

Monopolar diathermy was introduced in the early 1950s for tubal sterilisation [3]. Strangely enough, complications from burns did not lead to safer alternatives for many

years. They only came with the development of bipolar coagulation by Frangenheim in Germany [4] and Rioux and Cloutier in Canada [6] and with the introduction of the even safer thermocoagulation by Semm in Germany [7]. Eventually, mechanical occlusion methods emerged for tubal sterilisation which totally eliminated electrosurgical risks. The best-known of these is the Filshie clip, first reported in 1981 and still in use today [8].

In the meantime, thermocoagulation and the development of the endosuture developed in 1977, led Semm to develop new instruments and techniques which widened the range of operative procedures [9]. These now included ablation of endometriosis, adhesiolysis, adnexectomy, myomectomy, ovarian cystectomy, and salpingotomy for ectopic pregnancy as well as appendicectomy [9].

The veni, vidi, vici of videolaparoscopy

In the mid-1980s, the development of the modern chip camera and closed circuit television allowed through-the-lens viewing to be replaced by video monitoring. These advances came to fruition in the practice of videolaparoscopy, which was popularized by Nezhat [10] and rapidly replaced naked eye laparoscopy by the early 1990s.

Videolaparoscopy avoided the operator's back-breaking posture of lateral flexion that was needed to peer down the laparoscope and which inevitably limited the duration of laparoscopic procedures. It had other major advantages. The camera could be held by an assistant permitting the surgeon to operate with both hands, an essential prerequisite for the development of laparoscopic suturing and prolapse repair. Everyone in the operating theatre could view the procedure facilitating a team approach and better teaching. Surgery could be recorded on video tape and used as a permanent record. New techniques could easily be shown to colleagues. This helped to

spawn the formation of multiple societies of gynaecological endoscopy around the world, including the Australian Gynaecological Endoscopy Society (AGES) in 1990.

Videolaparoscopy also had many advantages over laparotomy. It magnified pelvic and abdominal anatomy enabling microsurgical procedures. The pneumoperitoneum improved microvascular haemostasis, giving a dryer and cleaner operating field. Surgical access and visualization were better in areas that were difficult to reach with open surgery, such as the pouch of Douglas and the posterior leaf of the broad ligament. For the patients, operative laparoscopy gave a better cosmetic result, less postoperative pain, a shorter convalescence, and it caused fewer adhesions than open surgery.

Rise and fall of laser laparoscopy

In 1973, Kaplan introduced the carbon dioxide (CO_2) laser into gynaecology for the treatment of cervical dysplasia [11]. By 1979, Bruhat in France had applied the CO_2 laser to laparoscopic surgery [2]. The term videolaseroscopy was coined by Nezhat and referred to laser laparoscopy with video monitoring [10]. Nezhat [10] and Daniell [12] popularized it in the English-speaking world. In the mid-1980s, the CO_2 laser became widely adopted following a common pattern from treating dysplasia of the lower genital tract to laser laparoscopy. The adaptation of the CO_2 laser to laparoscopy required several innovations in equipment and operating technique: an articulated optical arm to deliver the laser beam from its generator to the operating laparoscope or laser probe; a laser hand piece that was leak-proof and accepted CO_2 to keep the lens free of debris; the addition of a helium-neon sighting laser to add a coloured light to the invisible CO_2 beam; the development of a smoke evacuation system whilst simultaneously maintaining the pneumoperitoneum; and the use of an instrument or

fluid to absorb stray energy. Laser laparoscopy was used to vaporize endometriosis, separate pelvic adhesions, and treat tubal pregnancy by linear salpingotomy [2].

In the 1970s and 1980s, microsurgical instruments were adapted to laparoscopy and used to perform benign adnexal surgery with diathermy or endocoagulation as energy sources [2]. These electrosurgical instruments were easier to use and less expensive than laser laparoscopy. Their uptake was so rapid that laser laparoscopy was superseded within a decade of its development. It earned laser the reputation of being 'technology in search of work.'

Learning from ectopic pregnancies

During the 1980s early diagnosis of tubal ectopic pregnancy was greatly facilitated by sensitive and rapid assays for human chorionic gonadotrophin and improvements in the availability and quality of gynaecological ultrasound. Developments in laparoscopic techniques followed pace and resulted in open salpingectomy and salpingotomy being replaced by their laparoscopic equivalents. These included use of the Endoloop® (Ethicon, Endo-Surgery, Inc.), a precursor to the development of slip knots which are now commonly used in laparoscopic prolapse surgery. The application of laser laparoscopy and electrosurgery to the treatment of ectopic pregnancy taught gynaecologists many important lessons that were relevant to laparoscopic pelvic floor repair later on. Perhaps the key lesson was that minimally-invasive surgery should strive to be technically and technologically simple and inexpensive.

This was best exemplified in the Triton (Microfrance), an instrument designed for the treatment of ectopic pregnancy by salpingostomy. The 7 mm wide shaft of the Triton incorporated three elements: a retractable monopolar needle for salpingostomy,

an irrigation channel to loosen the ectopic by aqua-dissection, and a suction channel to extract it. At one French centre, the average time taken to remove an ectopic with the Triton was an impressive 8 minutes [13].

The emergence of new procedures

The 1980s heralded the arrival of several advanced laparoscopic procedures. Starting from laparoscopically directed appendicectomy and laparoscopic cholecystectomy the range of procedures in general surgery rapidly expanded to include hernia repair, vagotomy, and bowel resection.

In gynaecology, the treatment of endometriosis progressed from coagulation to excision and, in 1989, Reich and colleagues in the USA published their landmark paper on laparoscopic hysterectomy [14]. In the same year Reich presented the technique at the first world congress of gynaecologic endoscopy in France. Despite creating a sense of incredulity in the audience, his technique was adopted rapidly and the first such procedure was performed in our unit in 1991.

A plethora of techniques for laparoscopic hysterectomy ensued around the globe leading Garry, Reich and Liu to formulate a simple classification system [15]. This categorized procedures as laparoscopically assisted vaginal hysterectomy (LAVH) if the uterine vessels were ligated vaginally, laparoscopic hysterectomy (LH) if they were secured laparoscopically, laparoscopic supracervical or subtotal hysterectomy (LSH) if the cervix was preserved, and total laparoscopic hysterectomy (TLH) if the entire procedure, including vault closure, was done laparoscopically.

The transition from the hybrid procedure of laparoscopically assisted vaginal hysterectomy to the pure total laparoscopic hysterectomy was greatly facilitated by the development of vaginal fornix presenters and safer energy sources, such as the harmonic scalpel [16], which had less lateral thermal spread than diathermy. The

prime Australian example of a vaginal fornix presenter is the tube developed by McCartney [17]. This simplified the colpotomy procedure, reduced the risk of injury to surrounding structures, and preserved the pneumoperitoneum during colpotomy, specimen removal and vault closure. McCartney's tube was later used to facilitate excision of the enterocoele sac during laparoscopic pelvic floor repair.

The impact of laparoscopic hysterectomy on gynaecological surgery was far-reaching. Reich's main aim of reducing the proportion of hysterectomies that required open surgery was never fully achieved. However, laparoscopically assisted vaginal hysterectomy had the spin-off of improving vaginal operating skills and total laparoscopic hysterectomy became important for acquiring laparoscopic skills in pelvic dissection, haemostasis and suturing, all of which were essential prerequisites for laparoscopic pelvic floor repair.

Laparoscopic suturing widens the surgical spectrum

Significant advances in laparoscopic suturing occurred during the last three decades of the 20th century. In the 1990s these facilitated the development of techniques for pelvic floor repair, total laparoscopic hysterectomy and the treatment of operative complications, such as bowel and urinary tract injury. These techniques maintained the pneumoperitoneum by the development of novel suturing equipment and ports, direct and indirect (back-loading) methods of needle and suture introduction, and various knot-tying techniques. The latter included intracorporeal knot tying, the use of extracorporeal slip knots, and extracorporeal knot tying using knot pushers [18].

The first report of laparoscopic pelvic floor repair came from an Italian group in 1986 which published on laparoscopic uterosacral hysteropexy [19]. In 1991, Vancaillie and Schuessler reported laparoscopic bladder neck suspension [20].

Anatomically, the technique described was closer to a Marshall Marchetti Kranz procedure than to a Burch colposuspension. The treatment of vaginal vault prolapse by laparoscopic sacral colpopexy was first performed by Wattiez et al. in 1991 [21]. In 1996, Ostrzenski published on laparoscopic colposuspension for the treatment of total vaginal prolapse [22], and a year later Richardson, Saye and Miklos reported the first laparoscopic repair of paravaginal defects [23]. In 1997, Rosen and Lam [24] described a suturing technique for enterocoele repair which was widely adopted in Australasia.

A New Century of Continence Surgery and Pelvic Floor Repair

In the current millennium, there has been a strong trend to abandon Burch colposuspension in favour of synthetic mid-urethral slings for the treatment of urodynamic stress incontinence from urethral hypermobility [25]. There is also a tendency, albeit less pronounced, to replace traditional vaginal and laparoscopic repair by transvaginal pelvic floor repair augmented by grafts or mesh, especially for recurrent prolapse [26, 27]. In units with a laparoscopic interest, mesh sacral colpopexy is emerging as the most popular laparoscopic prolapse repair procedure [28]. These trends have been facilitated by improvements in laparoscopic suturing instruments, suture materials, and screw applicators, as well as the development of a variety of tapes, meshes, grafts and mesh-kits specifically designed for incontinence and prolapse surgery.

Currently, the laparoscopic pelvic floor surgeon has a wide range of procedures and techniques to choose from [29]. In the anterior compartment laparoscopic paravaginal repair is a good native tissue alternative to colporrhaphy for primary cystocoele repair [30]. Apical support failure is effectively addressed by laparoscopic

uterosacral ligament suspension especially when combined with hysterectomy [31]. Combined apical and posterior defects, including enterocoele, can be treated by laparoscopic supralevator repair or mesh sacral colpopexy [32, 33].

Living through history

In our hospital, which opened in 1976, developments have followed trends seen elsewhere. In the first decade, the range of procedures was limited to diagnostic laparoscopy, ovarian cyst aspiration, diathermy of endometriosis, and tubal sterilization using fallope rings or Filshie clips. By the late 1980s, clinical trials were conducted on the treatment of unruptured tubal ectopic pregnancy using intralesional methotrexate and laser salpingostomy [34, 35]. By the mid-1990s, virtually all benign adnexal surgery was performed laparoscopically with simple instruments and electrosurgery. At the same time, laparoscopic hysterectomy and Burch colposuspension were introduced [36, 37]. By the late 1990s, total laparoscopic hysterectomy had replaced laparoscopically assisted vaginal hysterectomy and laparoscopic entry techniques were expanded [38, 39]. Concurrently, improvements in suturing instruments, extracorporeal knot-tying and growing experience resulted in shorter operating times, lower rates of accidental injury and fewer conversions to open surgery.

In 1997, the ground-swell of enthusiasm for minimally-invasive procedures in general, and laparoscopic pelvic floor repair in particular, culminated in the formation of an endogynaecology unit (Flinders Endogynaecology) and urogynaecology unit. Its founding members were Drs Enzo Lombardi, Robert O'Shea, Elvis Seman and Christopher Verco. An endogynaecology fellowship was established and regular educational meetings programmed. Attending up to four operating lists per week, has

enabled the endogynaecology fellows (Table 2) to acquire a broad, hands-on experience of advanced endogynaecology and urogynaecology procedures.

Since 1999, Flinders Endogynaecology has held annual and at hoc workshops featuring a host of national and international authorities, listed chronologically in Table 3. Surgery workshops have gradually evolved from having live operating with interactive discussion to delegates actively involved in extensive hands-on training. Since 2002, annual two-days training courses, entitled "Mastering laparoscopic suturing," have been held.

Table 2. List of previous and current endogynaecology fellows

Year	**Fellow**	**Origin**
1997	Tarsha Basheer	South Australia
1998	Wendy Hodge	Tasmania
1999	Simon Gordon	New Zealand
2000	Martin Ritossa	South Australia
2000	Jane Wood	South Australia
2001	Jennifer Cook	New South Wales
2002	Jennifer Cook	New South Wales
2003	Paulette Maroun	New South Wales
2004	Fariba Behnia-Willison	New South Wales
2005	Fariba Behnia-Willison	New South Wales
2006	Carl Lam	Western Australia
2007	Jane Thorn	South Australia
2007	Ruben Vanspauwen	Belgium
2008	Ruben Vanspauwen	Belgium
2009	Sara Armitage (née Gibberd)	Western Australia
2010	Nicholas Bedford	New Zealand
2011	Nicholas Bedford	New Zealand
2012	Claire Francis	Victoria
2013	Brendan Miller	Queensland
2014	Brendan Miller	Queensland
2015	Yogender Yadav	India

From the past to the future

The prehistory of endoscopy took about 20 centuries characterised mainly by an absence of noteworthy developments. Its proper history took only one century, but it was exciting and eventful, shaped by many people with vision and ideas who laid the foundations of where we stand today. What was considered key-hole surgery at one time no longer requires an eye glued to the lens. Everyone can view and learn from what is seen through the key-hole. Inevitably, the better everything can be seen by different eyes, the more likely this will inspire a continuation of innovative thoughts that have shaped laparoscopic surgery thus far. A reassessment of pelvic floor surgery 10 years on may look very different from what it is today. We must always strive to ensure, though, that what is new is also better.

Table 3. Visiting teachers and their contributions to the annual workshops

Visiting Teacher	Origin	Teaching Contribution
Dr John Taylor	Western Australia	Tension-free vaginal tape
A/Prof Alan Lam	New South Wales	Laparoscopic posterior compartment (supralevator) repair and anterior paravaginal repair with Key sutures, total laparoscopic hysterectomy, adhesiolysis, ureteric stenting.
Dr Harry Reich	USA	Laparoscopic myomectomy
Dr Duncan Turner	USA	Laparoscopic hysterectomy
A/Prof Peter Maher	Victoria	Laparoscopic hysterectomy, electrosurgical excision of infiltrative endometriosis, robotically-guided video laparoscopy
Prof Tony McCartney	Western Australia	Total laparoscopic hysterectomy using the McCartney tube
Dr Thomas Lyons	USA	Laparoscopic supracervical hysterectomy, enterocoele sac excision and Lyons-Lui uterosacral colpopexy
Dr Bruce Farnsworth	New South Wales	Anterior and posterior intravaginal slingplasty, posterior repair with skin bridge, total vaginal mesh repair
Prof Robert Kovac	USA	Vaginal hysterectomy using endo-GIA, site-specific vaginal repair, sacrospinous colpopexy
Prof Carl Zimmermann	USA	Site-specific vaginal repair, uterosacral colpopexy
Dr Greg Cario	New South Wales	Laparoscopic hysterectomy, Burch colposuspension, adhesiolysis, mesh sacral colpopexy
Prof A J Rane	Queensland	Monarch sling, Perigee and Apogee mesh repair, vaginal mesh excision, Mini Arc Precise sling
Dr Graham Hamdorf	South Australia	Vaginal hysterectomy, Miya hook sacrospinous colpopexy, anterior colporrhaphy with waist-coating
A/Prof Christopher Maher	Queensland	Prolift mesh repair, TVT-O sling, fascial posterior repair, laparoscopic mesh sacral colpopexy and paravaginal repair
Dr Marcus Carey	Victoria	Excision of vaginal mesh, laparoscopic mesh sacral colpopexy, adhesiolysis, Prosima mesh repair
Dr Christopher Barry	South Australia	Apogee and Perigee mesh repair
Dr Michael McEvoy	South Australia	TVT-O sling, Prolift mesh repair
Prof Peter Sand	USA	Digitally-guided posterior repair, TVT sling Surgisis anterior repair (arcus to arcus)
Dr John Miklos	USA	Laparoscopic mesh sacral hysteropexy, multi-layered posterior vaginal repair
Dr Anna Rosamilia	Victoria	Posterior Pinnacle mesh repair, Capio sacrospinous fixation
Dr Danny Chou	New South Wales	Laparoscopic hysterectomy using harmonic and modified bipolar energy sources.

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CHAPTER 2

Survey of current management of prolapse in Australia and New Zealand

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ABSTRACT

Objective: To compare current practice in the treatment of pelvic organ prolapse between Australasian and British gynaecologists.

Methods: A postal questionnaire containing questions on four case scenarios, which examined contentious areas of contemporary prolapse management, was sent to 1471 Australian and New Zealand gynaecologists in mid-2007. The results were compared with those of an identical survey conducted in the United Kingdom in 2006.

Results: The response rate was 13% as only 196 complete responses were received. For primary anterior vaginal prolapse, anterior colporrhaphy was the procedure of choice in 54% followed by vaginal repair with graft in 20%. For recurrence, 75% used a graft. Procedure of choice for uterovaginal prolapse was a vaginal hysterectomy with anterior colporrhaphy (79%) and for vault support, 54% performed uterosacral colpopexy. In women wishing to retain their fertility, 23% would operate and a laparoscopic uterosacral hysteropexy (39%) was preferred. For posterior vaginal prolapse, the procedure of choice was midline plication in 56% and site-specific repair in 24%. A graft was used in 13% for primary repair and 61% for recurrence, most preferring permanent mesh. Procedure of choice for apical prolapse was sacrospinous fixation with anterior and posterior colporrhaphy (37%), followed by vaginal mesh repair (33%) and abdominal sacrocolpopexy (11%). Few respondents objectively measured prolapse (20%) or followed up patients over one year (12%).

Conclusions: Australian and New Zealand gynaecologists used fewer traditional transvaginal procedures and more vaginal grafts than their British colleagues in all compartments. Most respondents favoured permanent mesh (e.g. mesh kits) and many are missing an opportunity to gather valuable prospective data on these new procedures.

Introduction

Pelvic organ prolapse affects up to half of women over the age of 50, with a lifetime prevalence of 30–50% [1]. The lifetime risk of undergoing prolapse surgery by the age of 80 is 11.1% and of women undergoing surgery, about one-third need a second procedure within two years of primary repair [2]. This high failure rate has led to the introduction of a plethora of new procedures and to date, trainees and fellows of the Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG) have never been surveyed to ascertain current practice in prolapse surgery. This paper presents the results of a survey conducted in Australia and New Zealand in 2007. Results were compared with an identical survey in the United Kingdom in 2006 [3]. Our aim was to determine how pelvic organ prolapse with associated pelvic floor disorders and urinary stress incontinence are presently managed in Australia and New Zealand, and compare this with clinical practice in the United Kingdom.

Methods

A postal questionnaire designed by Jha and Moran for a 2006 United Kingdom survey was used with permission and mailed by the Australian Gynaecological Endoscopy Society (AGES) to every practising and training gynaecologist in Australia and New Zealand. The seven-page questionnaire was sent to 1,471 practitioners in mid 2007. It contained questions on four case scenarios, which examined contentious areas of contemporary prolapse management. The survey also assessed practitioner profile, classification of prolapse and duration of patient follow-up. To encourage every gynaecologist to participate, all respondents were offered a place in a draw for a bottle of Grange Hermitage wine.

The analysis was performed by looking at the overall response percentage to each

individual question using SSPS software (SPSS Inc, Chicago, Illinois, USA). The responses between Groups A (special interest practitioners and urogynaecologists) and B (generalists) and between the United Kingdom and Australia and New Zealand were compared using the chi-square test and P-values, to determine if the difference in the response was statistically significant. A $P < 0.05$ was set as statistically significant.

Results

Of the 1,471 questionnaires that were mailed a total of 196 complete responses were received, resulting in a 13% response rate. Some criticised the complexity of the questionnaire and the lack of definition of procedures. This arose from our decision to use the original questionnaire to enable international comparison of results.

Profile

Sixty-five per cent of respondents classified themselves as generalists, 27% as gynaecologists with a special interest in pelvic floor disorders, 4% were urogynaecologists and 4% failed to classify. We combined the special interest practitioner group with the urogynaecologists group, to create Group A, as the latter group was too small to enable statistical comparison with the generalists, constituting Group B.

Prolapse classification

Thirty-five per cent of respondents classified prolapse by degree (1–4), 24% by grade (1–3), 16% by size (small / medium / large) and 22% objectively measured prolapse using either Pelvic Organ Prolapse Quantification system (POPQ) or the Baden–Walker halfway system. Prolapse was objectively measured by almost 50% of practitioners in Group A and 10% in Group B.

Follow-up

Half of all practitioners followed up their patients for only six weeks, 36% arranged follow-up for up to one year and only 14% continued this for more than a year. Patients were followed up for more than a year by 25% of practitioners in Group A, whereas this was only 9% in Group B.

Scenario 1: Anterior vaginal prolapse

A 45-year-old woman presented with a cystocoele and urinary frequency. Her POPQ diagram is shown in the figure below (scenario 1).

The procedures of choice are presented in Table 1, 66% of practitioners using rapidly absorbed sutures, 25% delayed absorbable and 7% permanent sutures. For primary prolapse repair, 20% used a graft, compared to 43% when the patient was elderly and not sexually active.

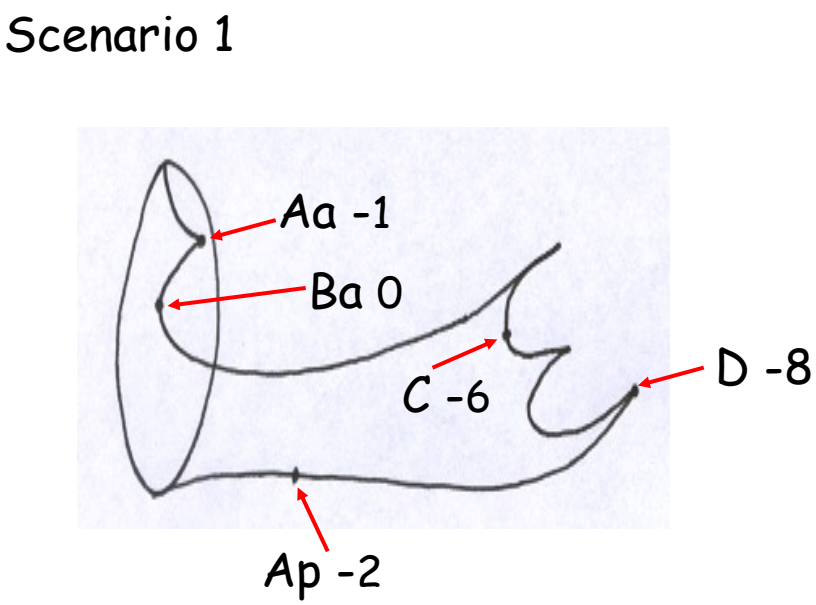


Table 1 Question 1: Anterior vaginal prolapse – procedures of choice

		ANZ (%)	UK (%)
Primary repair			
	Colporrhaphy	54	77
	Graft repair	20	10
	Synthetic	72	24
	Biological	14	76
	Paravaginal	12	6
	Other	14	7
When concurrent urodynamic stress incontinence			
	Mid-urethral tape	79	77
	Burch	13	11
	Other	8	12
Recurrent cystocoele			
	Colporrhaphy	10	45
	Graft repair	75	34
	Synthetic	84	28
	Biological	13	72
	Paravaginal	11	15
	Other	4	6

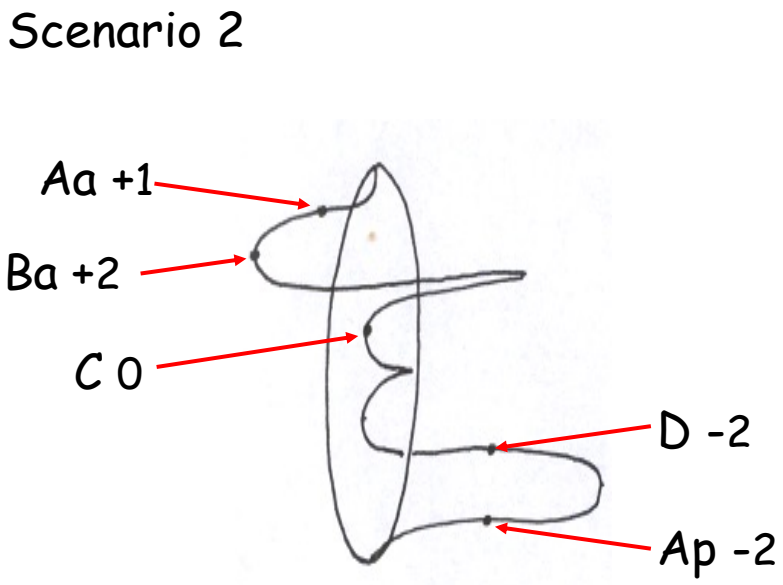
ANZ: Australia and New Zealand; UK: United Kingdom.

active and 75% for recurrent prolapse. A majority of grafts used were synthetic, predominantly commercial mesh kits. This was concluded from the fact that most respondents recorded their preferred mesh procedure.

If the woman was aged 35 years, requested surgery and wished to retain her fertility, 97% of gynaecologists would advise family completion before surgery. Gynaecologists with a special interest and subspecialists were less likely to perform a fascial colporrhaphy than generalists (33 vs 62%; $P < 0.001$). They were also more likely to perform a paravaginal repair (20 vs 9%; $P < 0.05$), use a graft (30 vs 12%; $P < 0.00001$) and choose delayed absorbable or permanent sutures (50 vs 26%; $P < 0.02$).

Scenario 2: Uterovaginal prolapse

A 65-year-old woman presented with a cystocoele and uterine descent. She had occasional urge urinary incontinence, but no stress incontinence with the prolapse reduced. Her POPQ diagram is shown below.



The procedures of choice are presented in Table 2. Preoperative urodynamics would be performed by 70%. If the patient was not sexually active, 92% of respondents offered the same procedure, whilst 4% performed a different procedure; hysteropexy, mesh kit or colpocleisis and 4% were undecided. The special interest / subspecialists group was less likely to perform vaginal hysterectomy and anterior colporrhaphy (62 vs 85%; $P < 0.001$). The surgical preference for uterine preservation procedures was similar.

Table 2 Question 2: Uterovaginal prolapse – procedures of choice.

	ANZ (%)	UK (%)
Primary repair		
Vaginal hysterectomy	79	82
Other	21	18
Preferred colpopexy technique		
Suturing uterosacrals to vault	54	63
Sacrospinous colpopexy	21	19
McCall	16	13
Posterior intravaginal sling	3	1
Other	6	4
When family incomplete		
Ring pessary	62	68
Uterine preservation surgery	23	24
Laparoscopic hysteropexy	39	-
Sacrospinous hysteropexy	27	26
Manchester repair	9	27
Abdominal sacrocolpohysteropexy	7	-
Posterior intravaginal sling	7	-
Other	11	47
Refer to Urogynaecologist	14	6
Advise against pregnancy and offer vaginal hysterectomy + repair	1	2

ANZ: Australia and New Zealand; UK: United Kingdom.

Scenario 3: Posterior vaginal prolapse

A 48-year-old woman presented with a rectocoele, incomplete rectal emptying, but no faecal incontinence. Her POPQ diagram is shown on the next page.

The procedures of choice are presented in Table 3. Preoperative colorectal referral was arranged by 14%. In the sexually inactive patient, only 6% would perform a different procedure, most often a graft reinforced repair or site- specific procedure. Gynaecologists with a special interest or subspecialists were less likely to perform posterior fascial colporrhaphy (43 vs 63%; $P < 0.02$) and more likely to use a graft for both primary (26 vs

8%; P = 0.001) and recurrent prolapse (74 vs 48%; P < 0.02).

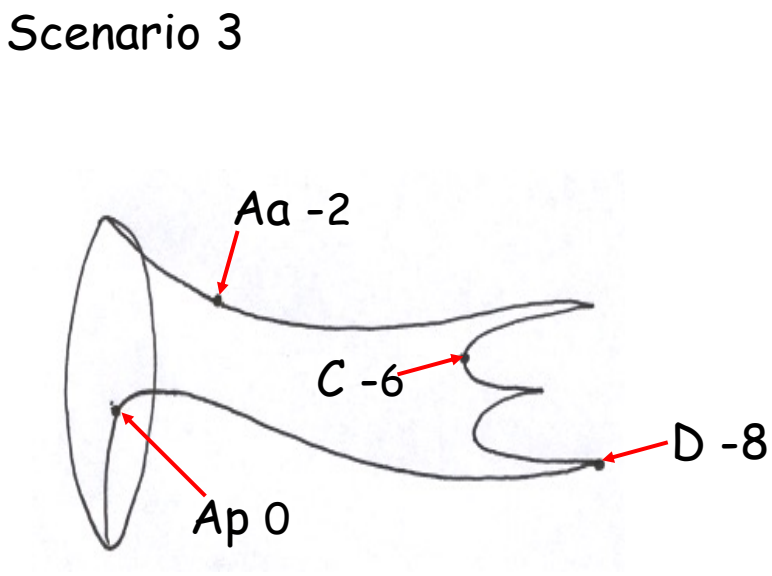


Table 3 Question 3: Posterior vaginal prolapse – procedures of choice

	ANZ (%)	UK (%)
Primary repair		
Colporrhaphy	56	7582
Site-specific repair	24	11
Graft repair	13	9
Synthetic	54	40
Biological	38	60
Skin bridge	6	-
Other	1	5
Recurrent rectocoele		
Colporrhaphy	18	38
Site-specific repair	12	6
Graft repair	61	49
Synthetic	66	44
Biological	28	56
Other	9	7

ANZ: Australia and New Zealand; UK: United Kingdom.

Scenario 4: Post-hysterectomy vaginal vault prolapse

A 56-year-old woman presented with post-hysterectomy prolapse and associated voiding difficulty. There was a hypermobile bladder neck, but no stress incontinence with the prolapse reduced. Her POPQ diagram is shown on the next page.

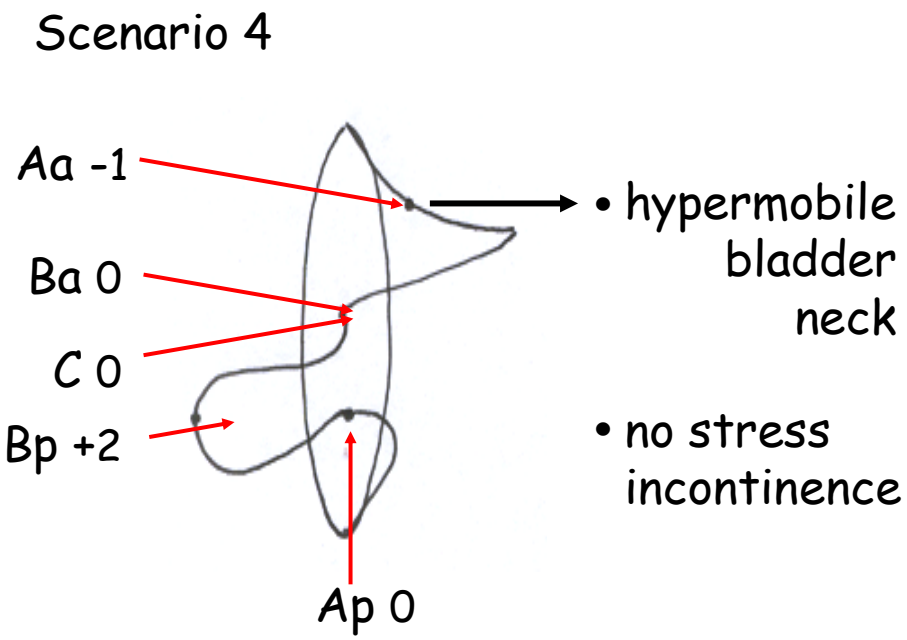


Table 4 Question 4: Post-hysterectomy vaginal vault prolapse

	ANZ (%)	UK (%)
Procedure of choice		
Sacrospinous colpopexy ± repair	37	19
Vaginal mesh repair	33	-
Synthetic	86	-
Biological	9	-
Abdominal sacrocolpopexy ± repair	11	38
Anterior + posterior colporrhaphy	2	28
Uterosacral ligament suspension ± repair	9	3
Posterior intravaginal sling ± repair	4	6
Iliococcygeal fixation ± repair	1	1
Other	3	5
Procedure of choice when elderly + sexually active		
Different procedure	4	-
Mesh repair	60	-
Uterosacral ligament suspension	20	-
Other laparoscopic repair	20	-
Procedure of choice when elderly + not sexually active		
Different procedure	11	16
Mesh repair	40	-
Anterior + posterior colporrhaphy	33	-
Colpocleisis	20	-
Other laparoscopic repair	7	-

ANZ: Australia and New Zealand; UK: United Kingdom.

The procedures of choice are presented in Table 4. Of all practitioners, 67% would operate, 32% would refer to a urogynaecologist and 1% did not complete this part of the questionnaire. Preoperative urodynamics would be performed by 47%. In the presence of occult stress incontinence, 46% of gynaecologists would perform a continence procedure, with a mid-urethral tape (78%) and Burch colposuspension (20%) as procedures of choice. With complete vaginal eversion, 60% of gynaecologists used permanent material in the repair, the breakdown being sacrocolpopexy (53%), vaginal mesh repair (40%) and laparoscopic suture repair (7%). In the special interest / subspecialists group, the procedure of choice was graft repair (47 vs 17%; $P = 0.06$), whilst generalists preferred midline plication (31 vs 17%; $P = 0.001$). In the case of complete eversion, the generalist group was more likely to add sacrospinous colpopexy to colporrhaphy (37 vs 13%; $P < 0.01$).

Discussion

This study has given us a valuable insight as regards which surgical procedures are currently being used to treat pelvic organ prolapse. In every field of medicine, the so called current practice is a constantly changing entity. As only a year elapsed between the British mail-out and ours, we believe that the survey results are more likely to reflect actual differences in practice during our snapshot of time rather than time-related differences arising from dissemination of new surgical techniques. As most respondents were generalists and special interest gynaecologists, the results have important implications for the education and training of gynaecologists in Australasia.

The relatively poor response rate of the survey could be explained by the fact that the questionnaire was sent to all Australia and New Zealand gynaecologists, including those not performing pelvic floor surgery. We used the questionnaire in its original format, which did not identify gynaecologists whose practice excluded urogynaecology or enable

them to respond without completing the questionnaire. Correcting this would undoubtedly have given a higher response rate, but without increasing our yield of survey data. In addition, respondents were deterred by the length and complex design of the questionnaire. However, simplifying the questionnaire would have complicated the comparison of the results with the British data.

Scenario 1

Anterior colporrhaphy remains the procedure of choice for repair of anterior vaginal prolapse in both surveys. The success rate of anterior colporrhaphy in the management of cystocoeles varies widely in literature (37–100%) and failure rates may increase if combined with a sacrospinous colpopexy due to posterior displacement of the vault [4, 5].

If we compare anterior colporrhaphy rate in the United Kingdom (77%) with Australia and New Zealand (54%), the difference is due mainly to 12% now preferring paravaginal repair and 11% favouring site-specific repair. In comparison with the United Kingdom, Australia and New Zealand gynaecologists used grafts twice as much and had a strong preference for synthetic mesh, while biological grafts were preferred in the United Kingdom, suggesting that they were less convinced about the potential advantages (greater durability) of graft-augmented repair and more concerned about the relative cost and complications of synthetic over biological mesh.

In the presence of concomitant urodynamic stress incontinence, the procedures chosen were similar to the United Kingdom and between practitioner groups A and B with minimally invasive slings replacing the Burch colposuspension as the gold standard.

Scenario 2

Preoperative urodynamics were equally performed in both surveys. Vaginal hysterectomy with anterior colporrhaphy was the procedure of choice for uterine prolapse and

cystocoele in 79%, which was similar to the United Kingdom. This contrasts with 54% of respondents choosing anterior colporrhaphy when there was an isolated cystocoele (Scenario 1). This large discrepancy could be explained by the fact that some surgeons may be dissuaded from using a mesh kit because of a higher mesh erosion rate with concurrent hysterectomy [6]. Moreover, it is increasingly evident that many women with prolapse have apical loss of support and hence repair of both compartments in this situation gives a better overall result and is therefore preferred. This practice contrasts with the United Kingdom where the anterior colporrhaphy rate was consistent in both scenarios. Also, in contrast to Australia and New Zealand, no difference was seen in the hysterectomy rate between different practitioner groups in the United Kingdom [3].

To support the vaginal vault, 70% of respondents performed a McCall culdoplasty or a plication of the uterosacral ligaments, the remainder (21%) opted for a sacrospinous colpopexy. This was the same in both surveys.

Scenario 3

Preoperative colorectal referral was similar in both surveys. Two randomised controlled trials compared transanal repair with vaginal posterior colporrhaphy and demonstrated better anatomical success rates in the transvaginal group, which remains the procedure of choice in both surveys [7, 8].

The need for a mesh-augmented repair of posterior prolapse is even more unclear than for anterior prolapse and accordingly, synthetic meshes are used less frequently. The use of absorbable mesh does not seem to improve the objective failure rate [9]. Paraiso et al [10] documented site- specific repair with porcine small intestine submucosal graft augmentation (biomesh) to have a higher anatomical failure rate when compared with posterior colporrhaphy or site-specific repair alone after one-year follow-up. There are several technical variations of posterior colporrhaphy, the optimum is still debated. Site-

specific repair, chosen by 24% of respondents, does not seem to offer better anatomical results [11].

Scenario 4

In the treatment of apical prolapse, three randomised controlled trials have suggested a higher success rate for abdominal mesh sacrocolpopexy over vaginal sacrospinous colpopexy, but with a higher morbidity [12-14]. British practitioners preferred sacrocolpopexy, whilst Australian and New Zealand respondents chose sacrospinous colpopexy more often. Uterosacral ligament suspension was preferred by 9 percent.

The question of what to do with occult stress incontinence is controversial. Australian and New Zealand and British gynaecologists are evenly divided into whether they would perform continence surgery, with British urogynaecologists strongly in favour (46 and 54% respectively). In patients undergoing abdominal sacrocolpopexy, Brubaker et al [15] showed that concomitant Burch colposuspension in women with occult stress incontinence, significantly reduced the postoperative stress incontinence rate from 44 to 24% after three months. Meschia et al [16] compared Tension-Free Vaginal Tape (TVT) with endopelvic fascia plication in women with prolapse and occult stress incontinence and reported less postoperative incontinence in the Tension-Free Vaginal Tape group. An Australian prospective randomised study comparing vaginal prolapse repair with and without Tension-Free Vaginal Tape in women with severe genital prolapse and occult stress incontinence found that a clinician would have to insert 26 Tension-Free Vaginal Tape slings unnecessarily to prevent one woman needing a sling at one year postoperatively [17].

In this case scenario, there was a trend to offer elderly patients vaginal mesh repair more often, particularly if they were not sexually active and had recurrent prolapse. This reflects that gynaecologists are concerned about the risk of dyspareunia with mesh repair.

The POPQ classification was introduced by the International Continence Society (ICS) in 1993 and subsequently recommended by AGES and the then Australian Association of Vaginal and Incontinence Surgeons (AAVIS) to their membership. With so many and relatively new procedures already in current practice, it seems a pity that only one-fifth of responders objectively measure prolapse and only 14% follow up patients for more than a year after surgery. Many practitioners are missing a great opportunity to gather prospectively clinical data, which could profoundly influence surgical practice in the future.

Conclusion

It is said that surgery is an art as much as a science. With few studies of high levels of evidence to guide gynaecologists, it is not surprising that there is a wide variation in the management of prolapse in each pelvic compartment. Australian and New Zealand gynaecologists seem to use fewer traditional transvaginal procedures in the anterior and posterior compartments and more vaginal grafts in all compartments than in the United Kingdom. Respondents preferred permanent synthetic grafts over biological grafts and most favoured mesh kits. Minimally invasive slings have revolutionised the treatment of stress incontinence in recent years.

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CHAPTER 3

Two-year experience with laparoscopic pelvic floor repair

This chapter was published as:

Seman EI, Cook JR, O'Shea RT. Two-year experience with laparoscopic pelvic floor repair. *J Am Assoc Gynecol Laparosc* 2003; 10: 38-45.

ABSTRACT

Study Objective. To evaluate the cumulative experience at our institution of laparoscopic pelvic floor repair to treat genital prolapse and associated symptoms.

Design. Retrospective analysis (Canadian Task Force classification II-2).

Setting. University hospital.

Patients. Seventy-three consecutive women treated surgically for symptomatic genital prolapse.

Interventions. Surgical treatment was site specific depending on findings on physical examination. Anterior compartment defects were treated by laparoscopic paravaginal repair, laparoscopic Burch colposuspension, or transvaginal anterior vaginal repair. Defects in the posterior compartment were treated by a combination of laparoscopic supralevator repair, laparoscopic vaginal vault suspension, enterocele sac invagination or excision, and transvaginal posterior vaginal repair. Anatomic defects in the apical compartment were primarily treated by laparoscopic vaginal vault suspension and enterocele sac excision. Patients whose anatomic anomalies contained elements of anterior, posterior, and apical compartments were classified in a global group.

Measurements and Main Results. Preoperatively, prolapse was considered as an attachment or fascial defect at DeLancey level I, II, or III. Each was then quantified by the pelvic organ prolapse quantification (POPQ) system and compartmentalized according to site of the major defect. Women were assessed by physical examination and repeat POPQ staging 6 weeks postoperatively and every 6 months thereafter. A standard interview was administered to assess functional status. Major complications occurred in 4.1% of women. Objective and subjective cure rates were 90% at 2 years.

Conclusion. Laparoscopic pelvic floor repair is an effective procedure with low morbidity. It should play a primary role in surgical management of DeLancey levels I and II attachment defects. For fascial defects, in particular DeLancey level II anteriorly and posteriorly, it should be complemented with vaginal repair.

Introduction

Genital prolapse is a common gynecologic condition and its frequency is increasing [1]. The aims of prolapse surgery are to restore anatomy [2], alleviate symptoms, and, it is hoped, preserve function.[3]. During the past decade there has been a paradigm shift from generic vaginal hysterectomy and repair to a site-specific approach [4] and increasing use of the laparoscope, which offers superior vision and surgical access [5]. Since laparoscopic pelvic floor repair was first described in 1995 [6], there have been few objective, standard evaluations of the procedure [7]. We evaluated an anatomic and site-specific approach to treat this disorder.

Materials and Methods

Seventy-three consecutive women (average age: 62.3 ± 12.4 yrs, average weight: 68.1 ± 12.5 kg, average parity: 3.2 ± 1.8) underwent laparoscopic pelvic floor repair by one of two surgeons (EIS: 60 cases, ROS: 13 cases). Initial conservative management consisted of pelvic floor exercises, topical estrogen, or a vaginal pessary (ring or Simpson shelf).

Prolapse was classified preoperatively into one of four categories according to site of the major defect and staged according to the pelvic organ prolapse quantification (POPQ) system [8] (both tandem and ordinal systems). Surgery was site specific and addressed attachment and fascial defects at DeLancey levels I, II, and III [9]. Twenty-four women were classified in the anterior compartment subgroup, 13 in the posterior, and 17 in the apical compartment subgroups; 19 women were in the global defects or mixed group.

The women were examined 6 weeks postoperatively and then at regular 6-month intervals. At each review a POPQ staging value was assigned. Objective cure was defined as POPQ stage zero or 1, indicating that the most distal level of prolapse was above the hymen. Conversely, POPQ stages 2, 3, and 4 indicated an unsuccessful operation. The POPQ system thus enabled results to be observed over time and anatomic failures to be defined objectively.

Subjective analysis was on the basis of a standard interview administered by a person not involved in the surgical procedures. Questions addressed current and preoperative symptoms related to bowel, urinary tract, and sexual function as well as general well-being (data available on request). Subjective cure was defined as absence of original symptoms of prolapse.

Data were analyzed with the SPSS 9.0 program.

Operative Procedures

All patients had preoperative bowel preparation the day before surgery and received prophylactic antibiotics preoperatively. They were placed in steep lithotomy position using Allen stirrups, and routine prophylaxis for venous thromboembolism was with intraoperative calf stimulators or sequential compression devices, with or without subcutaneous low-molecular-weight heparin daily until they were ambulatory. In general, procedures were performed in the following order according to defects present.

Supralevator Posterior Vaginal Repair

Supralevator posterior vaginal repair [2] (performed in 31 patients) was performed for level II posterior vaginal prolapse [9] resulting from posterolateral paravaginal attachment defects with or without fascial defects in the middle third of the posterior

vagina. The rectovaginal space was entered through an arch-shaped peritoneal incision made just medial to uterosacral ligaments. It was opened with the aid of rectal and vaginal probes by sharp and blunt dissection to the pubococcygeus portion of the levator ani, securing vascular anterolateral rectal pillars with bipolar diathermy. A ladder of loosely tied 0 Ethibond sutures (Ethicon, Endo-Surgery, Ryde, New South Wales, Australia) was created starting at the pubococcygeus inferiorly and ending superiorly at the level I support [9] remnants (cardinal and uterosacral ligaments). Each "rung" of the ladder involved one to two bites in the posterolateral endopelvic fascia and two to three subepithelial bites in the posterior vagina, and was placed 5 mm above the preceding suture. Myorrhaphy, or approximation of levators, was avoided as it is thought to predispose to postoperative pain and dyspareunia.

Enterocele Invagination

For this procedure (12 patients) the apical enterocele sac was invaginated with one to two figure-of-eight 0 Ethibond sutures, which approximated pubocervical to rectovaginal fascia, incorporating the sac into the neovagina. This gave unsatisfactory results and was replaced by enterocele sac excision.

Enterocele Excision

For this procedure (8 patients) the enterocele sac was elevated with a vaginal probe and the overlying peritoneum was incised [10]. The bladder was reflected anteriorly and the ureters laterally. A 35-mm McCartney tube, which facilitates total laparoscopic hysterectomy [11,12], was inserted into the vagina. Pneumoperitoneum caused invagination of the enterocele sac into the tube and defined the sac margin. The sac and a small amount of healthy vagina were excised with either monopolar diathermy or a Harmonic scalpel. Healthy pubocervical fascia was approximated to

healthy rectovaginal fascia with two to three figure-of-eight sutures of 0 monocryl. This was followed by vaginal vault suspension as described below.

Vaginal Vault Suspension

In vaginal vault suspension [13] (47 patients) the posterior pericervical ring remnant was suspended by two sutures of 0 Ethibond to uterosacral ligament remnants. These remnants were defined by a medial ureterolysis incision extending from the presacral region to approximately 1.5 cm lateral to the vaginal vault. Two sutures were placed clockwise. The first commenced at the insertion of the left uterosacral-cardinal remnant into the vault, and two to three horizontal posterior vaginal bites were taken clockwise, followed by two to three bites in the proximal right uterosacral ligament. The final bite was at the level of the presacral uterosacral ligament. The suture was tied firmly, elevating the vault to the right uterosacral ligament. The second suture commenced adjacent to the left presacral uterosacral ligament. Two to three bites were advanced clockwise, then attached to the left vault angle, posterior fornix, and right vault angle. Tying this suture centralized the elevated vault, and an adequate space was left for the sigmoid colon (minimum diameter 4 cm).

Laparoscopic hysteropexy is a modification of this procedure when the uterus was left intact and the uterosacral ligament remnants were anchored to the posterior cervix.

Paravaginal Repair

In this procedure (32 patients) the space of Retzius was approached transperitoneally, conserving the midline distal neurovascular supply of the bladder and urethra. Paravaginal spaces were opened by blunt dissection, defining the ischial spine, arcus tendineus, fascia, pelvis (white line), and pubic symphysis, and reflecting the bladder

medially if necessary. The defects were closed by approximating the anterolateral vaginal sulcus to the white line overlying the obturator internus with two to four sutures of 0 Ethibond, starting at the ischial spine and proceeding caudad.

Modified Paravaginal Repair

This procedure (5 patients) differed from paravaginal repair in that sutures were placed caudad to cephalad and each one included a third bite of the ipsilateral ileopectineal (Cooper's) ligament. These are called key sutures. The defect was closed by tying the knot and avoiding nonanatomic elevation of the vagina.

Burch Colposuspension

Laparoscopic Burch colposuspension was performed in five patients. The space of Retzius was opened transperitoneally and the distal bladder reflected medially. On each side the perivesical vagina was elevated to within 2 cm of the ipsilateral Cooper's ligament with two to three interrupted sutures of 0 Ethibond.

Burch Colposuspension with Tanagho Modification

The Tanagho modification (10 patients) was performed when Burch colposuspension and paravaginal repair were required simultaneously. Initially, paravaginal defect was repaired. Then two bow-strung 0 Ethibond Burch sutures were placed on each side, with the first at the level of the bladder neck, and the second 1 cm distally but no lower than midurethra level. This sequence was used to minimize the chance of one repair compromising the other.

Transvaginal Colporrhaphy Procedures

Anterior (17 patients) and posterior (26 patients) colporrhaphies were done for level II anterior fascial defects and levels II and III posterior fascial defects, respectively. The

steps were a midline incision over the defect, vaginal reflection, midline fascial plication with interrupted 1 polyglactin, judicious excision of redundant vaginal skin, and vaginal skin closure with interrupted 2-0 polyglactin.

Results

Mean operating time was 156 minutes (range: 45–390 min). More than 40% of women also underwent adhesiolysis, which accounted for an estimated 45 to 60 minutes of total operating time. An additional procedure was cystoscopy to confirm postoperative ureteric patency and exclude inadvertent intravesical sutures. Average estimated blood loss was 129 ml (range: 20–1300 ml). Average hospital stay was 5.4 days (range: 2–12 days).

The overall major complication rate was 4.1%; major complications being defined as bowel injury, ureteric injury, bladder injury, anesthetic complication, conversion to laparotomy, and estimated blood loss greater than 1000 ml [14]. One woman, who had had previous laparotomies, sustained a 12-mm puncture in the transverse colon at the time of primary cannula insertion. Another had a rectal perforation at the time of insertion of the rectal probe and bilateral ureteric occlusion by suture. Both cases were converted to laparotomy and the patients made a complete recovery. The first underwent concurrent open enterocele excision and vaginal vault suspension. The second declined further surgery and is being managed conservatively. One woman had an anaphylactic reaction to intravenous antibiotic and was converted to a vaginal procedure. Another had blood loss of 1300 ml from paravaginal varices and required a blood transfusion.

Minor complications were defined as urinary tract infection, pelvic hematoma or infection, symptomatic granulation tissue, port site infection or hematoma, and deep venous thrombosis [14]. The most common was urinary tract infection, which occurred in 12 women (16.4%). Eight women (11%) had prolonged urinary retention with residual urine volumes greater than 100 ml after day 7. Five (6.8%) had granulation tissue and experienced irregular vaginal bleeding. This was treated by a combination of methods including cauterization and excision. One patient had a port site hematoma and one had deep venous thrombosis.

All women were reviewed 6 weeks postoperatively and at regular 6-month intervals. Mean follow-up of objective assessment was 8 months (range 0–26 months). Twenty women have been followed for longer than 12 months at the time of writing. Three with defects in the anterior compartment had anatomic failure, giving an objective success rate of 87.5%. Two with defects in the posterior and global compartments had anatomic failure, giving objective success rates of 88.2% and 89.5%, respectively. The objective success rate of those with defects in the apical compartment was 100%. We observed only 2 failures in 23 patients who had severe genital prolapse (POPQ stages 3 and 4). One became evident 3 months and the other 12 months postoperatively. Transvaginal colporrhaphies were performed in 38 successful cases (52%) and in 3 of the 7 failures. Tables 1 through 4 show preoperative and postoperative POPQ scores. The overall objective success rate was 90% at 2 years.

We contacted 90% of women. They reported an average of 27 days (range 3–110 days) to return to normal activities. The overall subjective success rate was 90%, and 85% of those contacted would recommend the operation to a friend (Table 5).

TABLE 1. POPQ Scores for Anterior Compartment (n = 24)

POPQ Stage	Preoperative N (%)	Postoperative N (%)
1	0	8 (33.3)
2	14 (58.3)	2 (8.3)
3	10 (41.7)	1 (4.2)
4	0	0

Objective success rate 87.5%.

TABLE 2. POPQ Scores for Apical Compartment (n = 13)

POPQ Stage	Preoperative N (%)	Postoperative N (%)
1	0	7 (53.8)
2	8 (61.5)	0
3	2 (15.4	0
4	2 (15.4)	0

Objective success rate 100%

TABLE 3. POPQ Scores for Posterior Compartment (n = 17)

POPQ Stage	Preoperative N (%)r	Postoperative N (%)
1	0	2 (11.8)
2	11 (64.7)	1 (5.9)
3	3 (17.6)	0
4	2 (11.8)	1 (5.9)

Objective success rate 88.2%.

TABLE 4. POPQ Scores for Global Compartment (n = 19)

POPQ Stage	Preoperative N (%)	Postoperative N (%)
1	0	5 (26.3)
2	9 (47.4)	2 (10.5)
3	4 (21.1)	0
4	0	0

Objective success rate 89.5%

TABLE 5. Subjective Outcomes *

POPQ Stage	Preoperative N (%)	Postoperative N (%)
Stress incontinence	34 (46.6)	3 (4.1)
Detrusor instability	21 (28.8)	5 (6.8)
Urinary hesitancy	7 (9.6)	1 (1.4)
Sensation of lump	66 (90.4)	12 (16.4)
Fecal incontinence	6 (8.2)	0
Manual evacuation	12 (16.4)	0
Dragging, pressure	19 (26.0)	1 (1.4)

* This represents 90.4% of patients contacted

Discussion

It was estimated that women have an 11% lifetime risk of undergoing surgery for pelvic organ prolapse or urinary incontinence [15] and 29% require reoperation after (vaginal) prolapse repair [16]. Sixty-three percent of the women in this study had had an earlier vaginal repair.

Current laparoscopic techniques provide superior vision and surgical access over open and vaginal techniques, especially in hard-to-reach pelvic compartments. In our series, each prolapse was considered an attachment or fascial defect at DeLancey level I, II, or III and quantified by the POPQ system before and after surgery. Preoperatively,

this allowed us to assess prolapse on an individual basis and to adopt a site-specific approach. One disadvantage of the POPQ system is that paravaginal defects are not delineated. Postoperatively our classification facilitated detailed analysis of failures and a rational approach to modification of surgical technique.

In three patients repair of anterior pelvic compartment defects failed. The first patient had a laparoscopic paravaginal repair and transvaginal anterior colporrhaphy, and failure occurred 9 months after operation because of uterine prolapse (de novo failure of level I supports). The woman underwent laparoscopic hysteropexy and the prolapse has been objectively cured for 10 months. The other two failures in this category developed recurrent midline cystoceles that were evident 3 and 12 months postoperatively, respectively. The first manifested level II fascial defects and level I support failure 2 months postoperatively. This was managed conservatively with a Simpson shelf pessary. In the second patient, level II fascial defects were evident 3 months postoperatively. She was treated successfully with anterior colporrhaphy and free tissue transfer.

Our approach to anterior compartment prolapse was modified, and now involves the following steps:

1 Restore the integrity of the fibromuscular vaginal tube by ensuring that an enterocoele anterior to the vault scar is identified and excised with the aid of a McCartney tube or by reattaching pubocervical fascia to the pericervical ring per vagina.

2 Identify and treat the contribution of level I support defects to a cystocele if the vault is less than 4cm above the hymen, as described for vaginal vault suspension, avoiding over-correction.

3 Identify and treat paravaginal defects and use key sutures. Objective assessment of these defects is not possible with the POPQ system. Our observations suggest that paravaginal repair is more successful if anchored to the ileopectineal ligament. Initially in the series, paravaginal repair was combined with a Tanagho modified Burch colposuspension if the two procedures were required simultaneously. Currently, key sutures are used with overcorrection to give Burch-type elevation if both procedures are necessary.

4 To improve the failure rate of concomitant transvaginal colporrhaphy, we altered timing and technique. To ensure that laparoscopic and vaginal procedures do not compromise each other, surgery for midline pubocervical defects is deferred until prolapse is symptomatic. Anterior colporrhaphy with skin bridge is used for primary repair and free vaginal graft for a second anterior colporrhaphy.

Two patients with defects in the posterior compartments failed, one of whom had complete vaginal eversion (POPQ stage 4) preoperatively. The recurrent stage 4 prolapse became evident 3 months postoperatively. The woman's level 2 posterior supports remained intact. She underwent successful laparoscopic enterocele sac excision, vaginal vault suspension, and paravaginal defect repair. The second patient had anterior vaginal prolapse from unrepaired paravaginal defects and level I failure that became evident 12 months postoperatively. She is awaiting laparoscopic vaginal vault suspension and paravaginal repair.

Posterior compartment defect repair was modified and involves the following steps:

1 Identify posterior level II support defects and repair them with a supralevator posterior vaginal repair. This procedure also treats level II fascial defects.

2 Identify and excise an apical enterocele with a McCartney tube.

3 The excised sac is used as a free graft to the suture line of the neovagina if there is a recurrent enterocele or poor tissue strength.

4 Resuspend the vaginal vault to the uterosacral ligaments as described.

5 Assess perineal body mobility and reattach the rectovaginal septum to this by performing transvaginal posterior colporrhaphy.

The two failures in women with global defects were along the anterior wall. One was due entirely to postoperative constipation and inadequate aperient treatment. The woman had excessive daily straining for 2 months, resulting in de novo anterior wall prolapse (level II fascial defect). The vaginal vault and posterior compartment remained well supported. We now pay specific attention to postoperative aperient treatment, advising patients to avoid straining and heavy lifting for at least 3 months postoperatively, by which time 80% of wound strength has been achieved [17]. The other case involved a low midline cystocele (level II fascial defect) that became evident 2 months postoperatively. This was treated by anterior colporrhaphy using Panacryl to plicate the pubocervical fascia.

No failures occurred in the apical category (level I support defect), and we conclude that enterocele excision and vaginal vault suspension are excellent procedures for this problem. Longer follow-up may be necessary for failures to emerge, in which case the plan is to offer treatment with laparoscopic mesh sacrocolpopexy.

Notwithstanding the limitations of a retrospectively administered, nonvalidated questionaire, subjective analysis provides valuable information on each patient's interpretation of the impact of pelvic floor prolapse on her quality of life and how this was modified by surgical intervention. Constipation was reported by 10% of women preoperatively, and postoperatively 20% reported using laxatives. This exacerbation of

constipation is still well below that seen after open techniques, where a 150% increase in constipation was reported [18]. There were no cases of de novo detrusor instability, and each of the other functional parameters assessed was reduced.

We also studied sexual activity, noting that 40% of women were sexually inactive both preoperatively and postoperatively for reasons other than prolapse. Overall, if a woman complained of sexual dysfunction or dyspareunia preoperatively, she had a 50% chance of being cured of this symptom by the time of postoperative assessment. This is in contrast to open procedures, for which a 50% increase in dyspareunia was reported [18].

In terms of success rates and other functional parameters, the current series compares favorably with published results of laparoscopic, open and vaginal procedures for genital prolapse (Table 6) [7, 18-23]. Of note, several articles did not use a standard classification system to calculate objective success rates. Annual follow-up will continue on this cohort to provide long-term results.

Conclusion

Laparoscopic pelvic floor repair successfully restores genital anatomy, alleviates symptoms, and preserves function. We showed its short-term efficacy both subjectively and objectively, and believe it should have a primary role in the surgical management of levels I and II attachment defects. It is complemented with transvaginal repair of fascial defects, particularly level II anteriorly and posteriorly, performed either concomitantly or as a staged procedure.

Table 6. Published Series of Procedures to Treat Genital Prolapse

Procedure	No. of Procedures	Mean Follow-up (months)	Major Complications No. (%)[a]	Operating Time (min) (%)	Hospital Stay (days) (%)	Objective Success (%)	Subjective Success (%)	Dyspareunia (%)
Sacrospinous colpopexy[19]	243	74	22 (9.1)	n/a	n/a	79.7	n/a	10
Zacharin procedure[18]	126	25	58 (19.8)	180	n/a	92.4	94.9	11.2
Colposacropexy[20]	23	17	3 (13)	40	n/a	91[b]	n/a	4.3
Laparoscopic mesh[21]	20		0	20-48	0.5	n/a	80	0
Laparoscopic mesh[7]	35	5	1 (2.9)	254	4.8	80	90.9	10.3
Laparoscopic sacral colpopexy[22]	15	3-40 (range)	n/a	170	2.3	n/a	100	0
Laparoscopic sacrospinous colpopexy[22]	12	26	0	62	4	91[b]	n/a	n/a
Various laparoscopic procedures[23]	19	12	4 (21)	n/a	< 1	100[c]	n/a	0
Various laparoscopic procedures [d]	73	8	(4.1)	156	5.4	90	90.4	15.1

[a] Included transfusion, blood loss greater than 1,000 mL, ureteric injury, bowel injury, and pulmonary embolus.
[b] No details of objective assessment were given.
[c] Failures were subsequently reported.
[d] Current series.
n/a = not available.

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CHAPTER 4

Laparoscopic paravaginal repair of anterior compartment prolapse

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ABSTRACT

Study Objective: To assess the results of laparovaginal repair of anterior vaginal prolapse in terms of peri-operative morbidity and repair durability.

Study design: Longitudinal study of a consecutive series of women assessed with the pelvic organ prolapse quantification (POPQ) system before and after laparoscopic paravaginal repair of anterior vaginal prolapse.

Design Classification: II-2

Setting: University hospital in South Australia

Patients: 212 women having laparoscopic paravaginal repair for anterior compartment prolapse with average follow-up of 14.2 months and 10 (4.7%) lost to follow-up.

Interventions: All women underwent bilateral laparoscopic paravaginal repair which was combined with uterosacral hysteropexy or colpopexy in women with concomitant level I defects (n=42) and supralevator repair in those with posterior compartment defects (n=47). Recurrences were treated with graft-reinforced anterior colporrhaphy (n-18).

Measurements and Main Results: Nine women (4.2%) suffered major complications and there were 61 minor complications. POPQ assessment on follow-up (mean: 14.2 months) gave a prolapse cure of the laparoscopic repair of 76% (95% confidence interval: 70.7-82.1%). Eighteen of 23 women with a residual central defect subsequently had a graft-reinforced anterior colporrhaphy, after a mean interval of 14 months, which increased the cure rate to 84% (79.6-89.3%).

Conclusion: Laparoscopic paravaginal repair followed by graft-reinforced anterior colporrhaphy for central defects, when necessary, is associated with low morbidity and achieves an anatomical cure rate above 80%.

Introduction

A satisfactory cure rate for anterior vaginal prolapse has eluded gynecologists for a very long time [1,2]. The traditional surgical technique, anterior colporrhaphy, which has changed little since the early 19th century, is still widely used despite few published data on its durability and widely varying failure rates which range up to 70% [1,3]. It is based on the concept that cystoceles are usually caused by generalized relaxation or weakening of the anterior endopelvic fascia and that this can be corrected by plication [1,2].

An alternative approach was proposed by George R White in 1909, whose autopsy dissections indicated that anterior vaginal prolapse was caused by detachment of the pubocervical fascia laterally from the arcus tendineus fasciae pelvis (ATFP) [4]. That cystoceles could be reduced by repairing these defects was largely ignored until 1976, when Richardson et al. [5] described lateral, transverse (superior) and midline defects in the pubocervical fascia as responsible for anterior wall prolapse. Lateral defects have since been found in two thirds of women with anterior vaginal prolapse [6,7], although there is some discrepancy between preoperative and intraoperative diagnoses [7-9].

Paravaginal repair, first reported as a vaginal procedure in 1909 [4] and as an abdominal procedure in 1976 [5], has since been adopted as a laparoscopic procedure [10]. From 1999 onwards we adopted laparoscopic paravaginal repair as our preferred approach for correcting anterior compartment prolapse attributed to lateral defects, followed by later repair of residual central defects if deemed necessary, and started prospective evaluations using the pelvic organ prolapse quantification (POPQ) system [11]. This paper reports on our 5-years experience with this approach.

Patients and methods

Two hundred and twelve women with symptomatic anterior vaginal prolapse underwent laparoscopic paravaginal defect closure at Flinders Medical Centre, South Australia, from January 1999 to December 2004. The study was approved by the audit subcommittee of the institutional ethics committee.

The average age of the women was 60.3 years (range: 31-89); their average weight was 70.7 kg (range: 48-120); and their average parity 3 (range: 0-9). More than half of the women had had previous pelvic surgery with 25% having had previous prolapse surgery, but none had had a paravaginal repair (Table 1).

Table 1. Previous pelvic surgery in 212 women with anterior vaginal wall prolapse.

Previous procedure	No.	%
Hysterectomy	108	50.9
Colporrhaphy	44	20.8
Burch colposuspension	2	0.9
Sacrospinous colposuspension	1	0.5
Marshall-Marchetti-Kranz	2	0.9
Ventrosuspension	1	0.5
Any pelvic surgery	113	53.3

Preoperative measures

All patients were evaluated by the POPQ system using the Valsalva maneuver to assess prolapse in each compartment. Both the tandem and ordinal POPQ systems were used ensuring demonstration of the patient's maximal prolapse. The presence or

absence of anterior vaginal rugae and paravaginal sulci was noted. Patients were classified as having attachment defects only (absent sulci and intact rugae) or having both attachment and central fascia defects (absent sulci and rugae). Patients in the latter group (n=84; 39.6%) were counseled on the potential need for subsequent repair of the central defect.

The standard policy consisted of a trial of conservative measures, including local estrogen treatment, pessaries, and formal pelvic floor rehabilitation with a continence nurse or physiotherapist including instruction on non-Valsalva voiding and defecation, and measures to minimize intra-abdominal pressure rises. Surgery was only considered when conservative treatment failed or patients explicitly requested it.

Urodynamic studies were undertaken for women (n=103; Table 2) with urinary incontinence, voiding difficulties or moderate to severe prolapse (POPQ stages 3 or 4). Women with detrusor overactivity were managed conservatively.

All patients received preoperative bowel preparation with a laxative mixture the day before surgery and antibiotic prophylaxis and thromboprophylaxis intra- and postoperatively.

Laparoscopic repair

Patients are placed in steep lithotomy in Allen stirrups. A 4-puncture transperitoneal video laparoscopic approach is used to free adhesions and facilitate surgical access. Two 12 mm trocars are inserted centrally (infra-umbilically and 5 cm above the symphysis) and a 5 mm trocar on each side at the level of the umbilicus. The bladder is reflected traversing three layers: peritoneum, loose areolar tissue and the thin membrane overlying the ATFP. An arched peritoneal incision is made with diathermy scissors centrally between the two lateral umbilical ligaments and above the bladder

dome. The bladder is then reflected away from the pubic symphysis by blunt dissection of loose, largely avascular areolar tissue.

Thereafter, the membranous layer overlying the ATFP is divided hemostatically along its length. The bladder is bluntly dissected medially to reveal the paravaginal space, remaining anterior to the ischial spines and obturator bundles and clear of aberrant obturator vessels overlying the iliopectineal ligament. With a finger in the vagina the lateral sulcus is approximated to the ATFP to aid defect recognition. The torn lateral edge of the pubocervical fascia is revealed by blunt dissection of the bladder medially with a peanut shaped swab on a 5 mm grasper. Dissection is kept to a minimum to reduce bleeding.

Table 2. Results of urodynamic assessment in 103 women with urinary symptoms and./or POPQ stage 3 or 4 prolapse.

Urodynamic test result	No.	%
Mixed incontinence	61	59.2
Detrusor overactivity	19	18.4
Obstructed outflow	5	4.9
Urodynamic stress incontinence	20	19.4
Stable bladder	3	2.9
Occult urethral hypermobility	4	3.9
Intrinsic sphincter deficiency	1	1.0

Paravaginal defects are closed with 4 to 6 sutures of O Ethibond (Ethicon) starting from the distal point and alternating right and left sides to maintain vaginal symmetry. Up to 2001, one bite was taken in the lateral pubocervical fascia and

subepithelial vagina and one in the ATFP and obturator internus muscle, tying 3-4 knots. From 2001 onwards a third bite was taken in the iliopectineal ligament. The commonest configuration is 4 sutures on each side with the distal 3 as triple bite sutures and the proximal one taking one bite in the vagina and one in the iliopectineal ligament, omitting the obturator internus bite because of spatial restriction and the risk of neurovascular injury. Usually the sutures are tied without tension merely to close the defect, but tied more tightly if correction of urethral hypermobility is needed.

Concomitant level I defects are addressed by hysteropexy or colpopexy and all women with posterior compartment defects had a laparoscopic supralevator repair (Table 3).

Screening cystoscopy is performed to exclude intravesical sutures and to ascertain an intact bladder and normal ureteric function. A suprapubic catheter is inserted and secured. It is removed after two satisfactory residuals (i.e. both <100 ml and less than half the voided volume) are obtained.

Table 3. Concomitant procedures in 212 women undergoing laparoscopic paravaginal repair.

Concomitant procedure *	No.	%
Adhesiolysis	96	45.3
Supralevator repair	47	22.2
Hysteropexy / colpopexy	42	19.8
Enterocele excision	16	7.5

* All were laparoscopic procedures

Follow-up of patients and follow-up procedure

All patients were reviewed with POPQ assessments at 6 weeks, 6 months, 12 months and annually thereafter.

Patients with combined defects who remained or became symptomatic had a follow-up anterior colporrhaphy with a full thickness vaginal graft spanning intact vault and paravaginal supports. These patients received a preoperative enema the day before surgery, a prophylactic dose of a second generation cephalosporin after induction of anesthesia and intra- and postoperative thromboprophylaxis.

A diamond-shaped vaginal graft is harvested from the redundant part of the anterior vaginal wall by sharp dissection. The bladder is reflected by sharp dissection laterally to intact paravaginal sulci and cranially to intact DeLancey level I supports [12], and midline plication is made with interrupted 1 Vicryl from the bladder neck to the anterior fornix. The graft is laid back to front over the repair site securing it at the top to the level I supports, laterally to the arcus tendineus and suburethrally to the fascia with 2/0 Vicryl. The vagina is closed with locking 2/0 Vicryl and a vaginal pack and suprapubic catheter are inserted. Broad-spectrum antibiotics are given prophylactically for 5-7 days.

Results

Of the 212 women, 128 had lateral attachment defects only, while 84 (39.6%) had both attachment and central fascia defects (combined defects). The mean duration of follow-up was 14.2 months with 132 women having a follow-up of more than 12 months and 10 women lost to follow-up.

Operating time ranged from 50 to 255 minutes (average: 137 min); the range being dictated predominantly by concomitant procedures (Table 2). Median blood loss was 50 ml and hospitalization averaged 4.4 days (range: 2-17).

Table 4. Operative and postoperative complications.

Complication	No.	%
Major		
Blood loss > 1,000 mL	2	0.9
Bladder injury	7	3.3
Bowel injury	1	0.5
Unintended laparotomy	2	0.9
Minor		
Deep venous thrombosis	1	0.5
Granulation tissue	5	2.4
Pelvic hematoma	7	3.3
Pelvic infection	6	2.8
Prolonged urinary retention	22	10.4
Pyrexia > 38° C	2	0.9
Urinary tract infection	18	8.5

Nine women (4.2%) suffered major complications, defined as bowel, ureter or bladder injury, anesthetic complications, unintended laparotomy or blood loss >1,000 ml (Table 4). Seven women (all with previous surgery) sustained bladder injury. Two women underwent unintended laparotomy; one for intestinal obstruction when a small bowel loop was strangulated between vault suspension sutures, and one for control of bleeding. Three women (1.4%) were subsequently readmitted: one each for deep venous thrombosis, prolonged urinary retention or non-specific gastrointestinal upset. There were 61 minor complications (Table 4) with prolonged urinary retention,

defined as residuals greater than 100 mL by day 7 necessitating catheterisation, occurring in 10.3%.

Only 3 women had a failure at the site of paravaginal reattachment giving a success rate of 98.6% for recreation of the paravaginal sulci.

The objective success rate after laparoscopic repair, defined as a POPQ score < 2 at all times during follow-up, was 76.4% (Table 5) with the majority of recurrences (23/40; 57.5%) occurring in the anterior compartment in the 84 women with combined defects. Of the 84 women with combined defects, 56 (66.7%) had only a minimal asymptomatic degree of anterior wall prolapse on follow-up. Twenty-three had a recurrence of anterior wall prolapse despite restored sulci with symptoms occurring on average 14 months (range: 1.5-42 months) postoperatively. These women were offered an additional vaginal repair. Five declined surgery and 18 underwent anterior plication which corrected the anterior prolapse in all but one; the only one who had not received a vaginal graft. Two serosal inclusion cysts occurred in the 17 women with a vaginal graft; both resolved on simple aspiration. The compartments responsible for other POPQ scores ≥ 2, also occurring on average after 14 months (range: 2-39 months), are shown in Table 6.

Of the women with urodynamically demonstrated stress incontinence (Table 2), 75% reported to be fully continent at last follow-up, but no further urodynamic studies were conducted.

Discussion

Anterior compartment prolapse is a major challenge both for the women who suffer it and for the gynecologists whom they turn to for help. Regrettably, there is no universal

cure for this condition [8], but careful assessment using the POPQ system can go a long way in delineating the problem and seeking appropriate solutions.

Table 5. Pre- and postoperative POPQ assessments.

POPQ score	Preoperative		Latest postoperative score*			
			After laparoscopic repair only		After correction of the residual central defect **	
	No.	%	No.	%	No.	%
0	0	–	119	56.1	133	62.7
1	0	–	43	20.3	46	21.7
2	166	78.3	35	16.5	19	9.0
3	34	16.0	4	1.9	3	1.4
4	12	5.7	1	0.5	1	0.5
Total	212	100	202	95.3	202	95.3

* 10 women (4.7%) were lost to follow-up

** 18 women (8.5%) had a vaginal surgical correction of the residual central defect

Cystoceles were classified into those with lateral attachment defects, diagnosed when the paravaginal sulci became vertical during supine Valsalva, and those due to a combination of attachment and fascia defects. Central fascia defects were suspected when there was a loss of rugosity of the anterior wall on Valsalva and were thought to be due to transverse and midline pubocervical defects. The idea of combining paravaginal repair with anterior colporrhaphy for combined defects was abandoned because midline plication may counteract the paravaginal repair by pulling the lateral attachments away from the pelvic wall [1]. Thus, women with combined defects were informed that they might require a further vaginal procedure if they became or

remained symptomatic. This resulted in a two-staged approach with attachment defects corrected first and residual central defects being addressed later. It has recently been argued, however, that there is a need for a randomised study of anterior repair with paravaginal repair *versus* anterior repair alone and paravaginal repair alone [2]. Young et al. [13] reported on 100 patients treated concurrently with vaginal paravaginal repair and anterior colporrhaphy noting a paravaginal recurrence in 2% and midline recurrence in 22% within one year, but with a high complication rate. In our study, one third of the residual central defects were progressive and became symptomatic within four years of the primary procedure, but 64% of the patients with a central defect have thus far not needed a follow-up procedure.

Table 6. Failure rate (POPQ > 1 at the last assessment during follow-up).

Compartment	No.	%
Anterior	7	3.3
Central fascia defect	6	2.8 *
Central + paravaginal	1	0.5 **
Posterior	6	2.8
Vault	6	2.8
Global	2	0.9 **
Not specified	2	0.9
Total	23	10.8

* 18 women (8.5%) had undergone repair of a central defect of which 1 failed and 5 had declined further surgery.

** Considered as failures of laparoscopic paravaginal repair (n=3; 1.4%)

Even patients with unilateral defects underwent bilateral laparoscopic repair as prophylaxis and to maintain vaginal symmetry. Up to 2001, defects were closed with

one bite in the lateral pubocervical fascia and subepithelial vagina and one bite in the AFTP and obturator internus muscle. The subjective impression was that the lateral vaginal sulci were being restored bluntly and, therefore, a third bite in the iliopectineal ligament was added. This anchoring bite has two advantages. First, it suspends the lateral vaginal fornix from the iliopectineal ligament and not from a potentially atrophic obturator internus with poor suture retention. It also produces a sharper paravaginal sulcus. Second, it provides a standardized repair technique irrespective of urethral hypermobility. Without stress incontinence, the sutures are simply tied to achieve closure of the anatomic defect without elevation. With urethral hypermobility they are tied more tightly to achieve overcorrection.

An obvious weakness in our study is that symptoms and discomfort regrettably were not recorded in the same systematic way as POPQ assessments. While most patients, including those with POPQ scores ≥ 2, reported either a cure or marked improvement and 75% with stress incontinence reported resolution of the problem, symptoms were not elicited and documented in a sufficiently standardised manner to accord great validity to the data obtained.

Appropriate assessment of the results of prolapse surgery and paravaginal repair in particular is fraught with difficulties. First, lateral attachment defects often occur in association with other defects, as was the case in 40% of our patients. In fact, it has been argued that women with pelvic support defects rarely have a single site of involvement [14]. Second, the patient groups included in most reports, including ours, are mostly diverse in terms of previous surgery and presence or absence of incontinence. Third, the specified repair procedure is frequently performed with other procedures making it difficult to judge the relative contribution of each to the end result [2,13,15]. Also in our study 43% of women simultaneously had a level I

procedure to augment anterior support superiorly. Fourth, an excellent anatomical result is not necessarily reflected in a similar functional result and *vice versa* [16-18]. Fifth, prolapse and anterior compartment prolapse especially has a high recurrence rate [15-19]. Part of this may be due to unrecognized co-existing defects or to newly arising defects in other compartments, but reintervention for the same problem is common [2,18]. Long-term follow-up is therefore essential, but not always easy to achieve.

As a result, judging the relative merits of different procedures, whether open, vaginal or laparoscopic, has a degree of arbitrariness that is difficult to eliminate even when concentrating on studies with random allocation to different procedures [20]. The latter are also hampered by the fact that randomizing between complex procedures does not necessarily guarantee that each is performed with a comparable level of skill and associated conditions [21,22]. No trials involving a laparoscopic approach have been reported, however, and only one compared an abdominal with a vaginal approach [20]. Benson et al [18] conducted a randomised trial of abdominal versus vaginal paravaginal repair reporting a re-operation rate of respectively 16% and 33% within an average 2½ years follow-up. However, women in both groups had a range of other interventions including anterior colporrhaphy in 33% of the vaginal and 30% of the abdominal group, and results are only available for 80% of the women randomized. In the absence of firm standardisation of procedures and techniques [21] and a clear definition of outcome measures [16] controlled trials are not likely to be more informative than our cohort studies [23,24] and many others published thus far.

Despite these limitations in comparing our results with those of others reported in the literature, our results are encouraging even though the anticipated need for a follow-up procedure in a proportion of women may be perceived as a drawback. The

laparoscopic intervention alone achieved restoration of the lateral sulci in 98.6% of patients including those with combined defects. When considering only women with on-going follow-up and excluding those who declined the follow-up procedure for co-existing central defects, anterior compartment prolapse alone was satisfactorily corrected in 97% (191/197). Nevertheless, prolapse remained or became an issue again for 23 (10.8%) of our patients mostly because of prolapse in other compartments or because they declined the follow-up procedure. This further emphasises the need for clear definitions of recurrent prolapse that are evidence-informed and clinically meaningful [16], particularly as the demand for prolapse surgery is estimated to increase considerably over the next two decades [25].

Conclusion

Laparoscopic paravaginal repair cures anterior compartment prolapse in 76% of patients. Follow-up graft-reinforced anterior colporrhaphy for residual central defects increases the cure rate by 10%.

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CHAPTER 5

Long-term outcomes of laparoscopic repair of cystocoele

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ABSTRACT

Background: There is little information on the effectiveness of laparoscopic techniques for native tissue repair of cystocoele.

Aim: To assess the long-term outcome of laparoscopic cystocoele repair.

Methods: Two hundred and twenty-three women with symptomatic pelvic organ prolapse underwent laparoscopic paravaginal repair and treatment of associated conditions.

Patients were assessed preoperatively and postoperatively at 6 weeks, 6 months, 12 months and then annually or biannually with pelvic organ prolapse quantification (POPQ) and subjective assessment at each visit.

Results: Median follow-up was 5.2 years (range: 1-12 years) with 140 women (63%) followed for at least 5 years. During follow-up, 79% of women developed prolapse of at least POPQ stage 2 in one or more compartments and 58% became symptomatic again. Overall, 48% underwent further prolapse surgery, but only 24% of women had an anterior prolapse beyond the hymen. Thirty percent eventually had a further cystocoele repair.

Conclusion: Long-term follow-up of laparoscopic cystocoele repair shows that cystocoeles are difficult to repair successfully.

Introduction

The concept that a lateral detachment of the pubo-cervical fascia is one of the causes of anterior compartment prolapse is not new. The defect and its vaginal repair were first described in 1909.[1] Paravaginal repair received little attention, though, until Richardson and colleagues reported their experience with an open abdominal repair in the late 1970s.[2, 3] Laparoscopic approaches were developed subsequently.[4, 5]A review of the methods of lateral detachment repair showed cystocoele 'cure' rates ranging from 76 to 100% over 0.5-5.6 years for the vaginal approach and 59-97% over 0.5-6 years for the abdominal approach.[6]

We published our initial experience with laparoscopic paravaginal repair in 2003,[7] and reported a 3-year success rate of 79 percent in 2007,[8] using strict POPQ-based criteria,[9] We now present long-term outcome data, including some women who were followed for more than 10 years, using contemporary criteria of no bulge beyond the hymen, no prolapse symptoms, and no reoperation.[10]

Methods

From January 1999 to December 2005, laparoscopic repair was the preferred procedure for anterior compartment prolapse in our unit for operative laparoscopy and urogynaecology at Flinders Medical Centre.

Patients underwent standardized assessment and examination using the POPQ system.[9] The most dependent values in the anterior, apical and posterior compartments were recorded. Urodynamics were undertaken as required. Operations were performed by two of the authors and fellows under their direct supervision.

The operative technique, which is based on that of Miklos and Kohli [11] with some modifications, has been described previously.[18] A video laparoscopic

transperitoneal approach is used and the retropubic space is accessed via an arched peritoneal incision between the obliterated umbilical arteries and above the dome of the bladder. Blunt dissection and the effects of the pneumoperitoneum are used to enter the correct tissue plane of the space of Retzius, identified by loose areolar tissue, to visualise the obturator internus fascia and arcus tendineus fasciae pelvis (ATFP). The positions of the bladder edge, bladder neck and obturator neurovascular bundles are noted. A gloved finger is placed in the vagina to palpate the ischial spine and elevate the lateral sulcus back to the level of the ATFP. The bladder is then gently mobilised medially and a series of interrupted sutures is placed starting from the level of the bladder neck towards the ischial spine. A permanent, braided suture (0 Ethibond on CT2 needle; Ethicon, NJ) is used, usually placing 3 sutures per side. In a 3-point technique, each suture on the right side takes a pass through the pubocervical fascia and then through the obturator internus fascia/ATFP, before passing through Cooper's ligament. On the left side the sequence is from the obturator internus to the pubocervical fascia and then through Cooper's ligament. Sutures are tied extracorporeally without elevation of the anterior vaginal wall (unlike what is done for a Burch colposuspension). The objective is to approximate the pubocervical fascia to the ATFP and provide an additional point of attachment via Cooper's ligament to support the repair. The extra attachment to Cooper's ligament, while not a standard element of a paravaginal repair, provides better support to the lateral vaginal sulcus. Cystoscopy is performed to confirm bladder integrity and ureteric patency. A drain and a suprapubic catheter are inserted and the peritoneal incision is closed with an absorbable suture.

Peri-operative broad-spectrum antibiotics are routinely given, sequential calf compressors are used, and postoperative thromboprophylaxis with low molecular

weight heparin is administered until discharge. A trial of voiding begins on the first postoperative day and the catheter is removed when residual volumes are less than 100 mL and less than half the voided volume.

Postoperative review by a member of the team was at 6 weeks, 6 months, 12 months, and then yearly or biannually as required. At follow-up, patients were examined using the POPQ staging [9] and asked about prolapse symptoms. Any prolapse beyond the hymen was considered to be an anatomical failure. Subjective failure was determined as any symptoms of prolapse ranging from feeling a bulge up to sexual dysfunction. We also considered any further prolapse surgery as a failure, in particular if it involved the anterior compartment.

Categorical data were compared with the chi square test and continuous data with either Kruskal-Wallis or Mann-Whitney tests for non-parametric distributions. Associations were tested with binomial logistic regression and survival data generated with non-parametric Kaplan-Meier testing.

The study was considered an audit activity by the institutional ethics committee.

Results

In the 7 years period, 223 women underwent laparoscopic paravaginal repair and associated procedures and all had a follow-up of at least 12 months. Median follow-up was 62 months or 5.2 years (range: 1 to 12 years) with 106 women followed for more than 5 years. Only women with at least 5 years of data (n=140; 63%) contributed to the survival analyses presented.

Baseline characteristics are presented in Table 1, while Table 2 outlines intraoperative details, complications, and associated repairs. The most common intraoperative complication was cystotomy which occurred in 7 patients (3%), 5 of whom had had a hysterectomy previously. All cystotomies were repaired laparoscopically without subsequent complications. Postoperatively, 15 women (6.7%) suffered a urinary tract infection and 12 women (5.4%) had a suprapubic catheter for more than 7 days. De novo urgency symptoms developed in 10 women, 7 of whom had had a concomitant Burch colposuspension.

Table 1. Patient characteristics (n = 223).

Age in years (median; range)	62	35 - 89
Weight in kg (median; range)	68	45 - 120
Parity (median; range)	3	0 - 6
Previous hysterectomy (n; %)	108	48.4
Previous anterior repair (n; %)	39	17.5
Compartments involved (n; %)		
Anterior	93	41.7
Anterior + apical	49	22.0
Apical	7	3.1
Anterior + posterior	40	17.9
Global	34	15.2

Almost all women had an apical compartment repair (n=213; 97%) either laparoscopic uterosacral colpopexy in the case of previous or concurrent hysterectomy, or uterosacral hysteropexy if the patient requested uterine conservation. Forthy-seven

women (21%) also underwent a laparoscopic posterior repair. The outcomes of laparoscopic hysteropexy and laparoscopic posterior repair have been reported previously.[12, 13] Burch colposuspension was the most common procedure for stress incontinence (n= 91; 41%).

Table 2. Operative and postoperative details of the patients (n = 223).

Operating time in min (median; range)	135	60 - 390
Estimated blood loss in mL (median; range)	50	10 - 1300
Concomitant procedures (n)		
Hysterectomy with vault suspension		61
Uterosacral colpopexy after previous hysterectomy		102
Hysteropexy		50
Burch colposuspension		91
Laparoscopic enterocoele repair		16
Laparoscopic posterior repair suture		47
Posterior vaginal repair		4
Intra-operative complications (n)		
Cystotomy		7
Ureter ligation *		1
Bowel injury *		1
Blood loss >500 mL		5
Unintended laparotomy *		1
Postoperative complications (n)		
Deep venous thrombosis		1
Small bowel obstruction		1
Pelvic infection/hematoma		7
Port site hernia		4
Urinary tract infection		15
Suprapubic catheter for >7 days		12
Anterior suture granulations		0

* These 3 complications occurred in the same patient.

Preoperative and 1-, 3- and 5-year postoperative POPQ values for points Ba, C, and Bp are presented in Table 3. During follow-up, 130 women (58%) developed one or more symptoms of prolapse again at a median time interval of 18 months (Table 4). Over the entire follow-up period, an anterior prolapse beyond the hymen (Ba >0) occurred in 54 women (24%) of whom 38 underwent further surgery. Sixty-six women (30%) eventually had further anterior surgery (Table 4), although only 38 of them had a cystocoele beyond the hymen. Median time to re-operation was 32 months. Cumulative anterior re-operation rates are shown in Figure 1. Overall, 106 women (48%) had further prolapse surgery in one compartment or another after a median interval of 22 months (range: 3.5 to 120).

Table 3. Median and range of POPQ values preoperatively and at various times postoperatively.

	Preoperative		1 year		3 years		5 years	
No. of women	223*		157		137		140	
Ba	0	[-2 – 8]	-2	[-3 – 8]	-2	[-3 – 4]	-2	[-3 – 8]
C	-3	[-11 – 10]	-8	[-11 – 10]	-8	[-11 – 2]	-7	[-11 – 10]
Bp	-2	[-3 – 8]	-3	[-3 – 8]	-2	[-3 – 2]	-2	[-3 – 8]

* All but 7 women had POPQ stage ≥ 2 in the anterior compartment.

Subsequent operation in the anterior compartment was mostly a native tissue repair (43 of 66), either ‘traditional’ anterior colporrhaphy, using a series of interrupted delayed-absorbable sutures, or colporrhaphy plus full-thickness skin graft. For the latter, a narrow diamond of anterior vaginal mucosa was fixed to the boundaries of the anterior compartment with delayed absorbable sutures before vaginal closure. Another

14 underwent a biologic graft-reinforced repair (Surgisis; Cook Medical, Bloomington, Indiana), fixed to the sacrospinous ligaments apically, the ATFP laterally, and the bladder neck distally.[14] Nine, considered to be at serious risk of further problems, had permanent mesh.

Table 4. Number of failures and time to failure according to different definitions.

	Number of Patients	Time to failure in months		
		Median	Range	IQR *
NIH definition **	177	13	0.5 - 117	7 - 30
Main compartment POPQ with stage ≥ 2				
Anterior	81	13	1.4 - 93	7 - 25
Apical	18	11	0.9 - 101	6 - 24
Posterior	68	17	0.5 - 117	4 - 33
Global	10	11	7.4 - 76	8 - 70
Subjective failure †	130	18	1.4 – 117	9 - 37
Ba >0	54	38	5.8 - 125	16 - 57
Anterior reoperation	66	32	4.6 - 120	16 – 64
Any prolapse surgery	106	22	3.5 – 120	16 - 64

* Interquartile range.

** The National Institutes of Health definition refers to prolapse POPQ stage ≥ 2 (i.e., prolapse ≥ -1 in any compartment).

† Defined as awareness of a bulge or any prolapse symptom irrespective of the compartment involved.

Of the 43 women undergoing subsequent native tissue repair, 6 developed a further symptomatic bulge; 3 of them underwent repair with mesh. In total, 12 women (5%) ended up with a mesh repair.

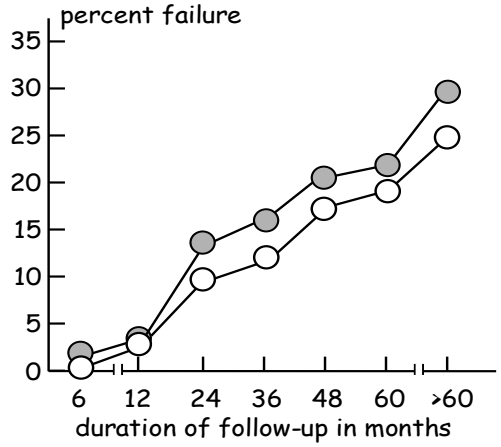

Figure 1 – Cumulative failure rates defined as Ba >0 (open circles) or reoperation rates (closed circles).

Of the 43 women undergoing subsequent native tissue repair, 6 developed a further symptomatic bulge; 3 of them underwent repair with mesh. In total, 12 women (5%) ended up with a mesh repair.

Figure 2 shows the survival curves for women with 5 or more years follow-up (n=140; 63% of the total cohort) in terms of Ba >0 and anterior compartment reoperation. There was no significant difference between the curves,

When analysing outcome data in relation to patient age, weight, parity, previous anterior repair, previous hysterectomy and baseline POPQ value, the only significant association with anterior failure beyond the hymen and anterior reoperation was the baseline Ba value (respectively $p < 0.001$ and $p < 0.015$). Binary logistic regression showed a significant association between point Ba at baseline and follow-up data at >5 years for both Ba >0 and repeat surgery ($p < 0.001$ for both). There was no relationship between point C at baseline and subsequent outcome. Previous

hysterectomy, previous anterior repair, concomitant Burch colposuspension, age and weight were not significantly associated with a new cystocoele beyond the hymen or reoperation.

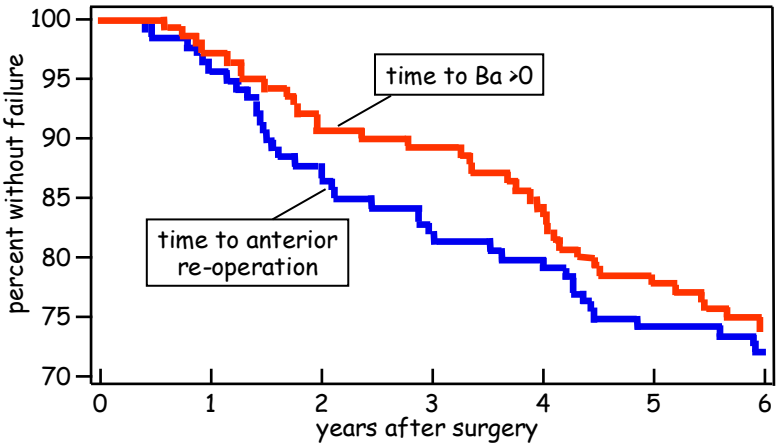

Figure 2 – Survival curves for Ba >0 and re-operation in women with follow-up of 5 years or more.

Discussion

Historically, the main surgical treatment for cystocoele has been midline plication. Although several alternatives have been introduced, it has remained the operation of choice.[15] Unfortunately, a large proportion of cystocoeles are due to a lateral detachment of the pubocervical fascia from the white line.[16] Midline plication does not address this defect and may even exacerbate it.

There have been three approaches to paravaginal repair: vaginal, abdominal (open) and laparoscopic.[1, 2, 4] While the latter depends on laparoscopic suturing skills, once these are mastered, the laparoscopic approach offers superior visualization and access to the paravaginal spaces. It also avoids the morbidity of open abdominal surgery and the high complication rate of the vaginal approach.[17]

The introduction of mesh kits, which provide support via paravaginal and apical anchorage, created a major shift in the treatment of cystocoele. When mesh-related complications led to the withdrawal of several mesh kits, many gynaecologists returned to their former practice of anterior colporrhaphy. One may wonder why laparoscopic native tissue repair remained largely overlooked as an alternative approach.

In our cohort, 18% of women had had a previous anterior colporrhaphy. We found that many of these women had paravaginal defects, characterized by blunting of the paravaginal sulci, and intact rugae around the midline scar. They are ideally suited for paravaginal repair. However, due to narrowing of the anterior wall, the lateral sulci may not approximate the white line during repair, requiring a degree of bowstringing. We found that new cystocoeles after laparoscopic repair were quite different from the primary cystocoele and typically presented as a central bulge with intact paravaginal and apical attachments. Over time, we identified a group of women who are at increased risk of failure after laparoscopic repair, namely those who have a saccular cystocoele that is devoid of rugae. We postulate that they have a significant deficiency of pubocervical fascia centrally, which may not be addressed adequately by lateral and apical attachment. These women, who are mostly over 50, are currently offered the option of a two-stage repair (a laparoscopic repair followed by colporrhaphy reinforced with a full thickness vaginal graft when required), or an alternative primary repair using a biological graft or permanent mesh.

In our study, 31% of women subsequently developed a rectocoele. Many of them had undergone a Burch colposuspension, which is known to increase the risk of posterior compartment prolapse. This problem may be avoided by treating coexistent

stress urinary incontinence with a mid-urethral sling instead of a Burch colposuspension.

When our data collection began, we had no standardized method for collecting quality of life outcomes. Nonetheless, the follow-up data permit to evaluate this procedure in terms of any prolapse symptoms, prolapse beyond the hymen in the treated compartment or further operation during follow-up.

Since the publication of our 2007 study on paravaginal repair,[8] three other studies on the laparoscopic approach have been published,[18-20] but it is difficult to compare the data because none of them provide POPQ data. Rosen and colleagues, using a similar technique to ours, found a similar recurrence rate with around 20 percent of women requiring a further procedure after global laparoscopic pelvic floor repair.[18] Rivoire et al. presented a series of 138 women undergoing global prolapse repair using mesh for the apical and posterior compartments of whom 40 underwent a concomitant paravaginal repair.[19] Specific results are not reported, but overall there was a low recurrence rate of 12% at a median follow-up of 34 months. Banerjee and Noé reported on a laparoscopic approach with a number of modifications, including the addition of a mesh inlay on each side.[20] Of 85 patients, 62 returned for follow-up at a mean time of 30 months. Rates of urinary retention (6%) and postoperative urinary tract infection (11%) were similar to those in our series. Our study actually provides the only long-term outcome data for laparoscopic cystocoele repair thus far.

Current understanding of the pathogenesis of cystocoele indicates that paravaginal and apical defects are a common feature of it and should be addressed when dealing with pelvic floor reconstruction. We prefer the laparoscopic approach to correct these defects because of the excellent access, vision and haemostasis it affords. The laparoscopic repair has the advantage of producing a visually perfect repair site: a

vagina of normal calibre, length and axis, with the lateral sulci restored and no visible wounds or sutures.

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CHAPTER 6

Laparoscopic treatment of enterocele: A 3-year evaluation

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ABSTRACT

Objective: To report the morbidity associated with the laparoscopic treatment of enteroceles and assess the durability of the repair.

Design: Prospective observational study.

Setting: University Teaching Hospital.

Population: Forty-five consecutive women with symptomatic enteroceles who underwent laparoscopic treatment of an enterocele.

Main outcome measures: Objective urogynaecological assessment using the pelvic organ prolapse quantification system.

Results: The 11% incidence of anterior wall prolapse is lower than that associated with previous reports of surgical procedures to treat enterocele. There is a 4.4% incidence of major complications. The procedure has been demonstrated to have a 93% success rate at 3 years in treating enterocele.

Conclusion: The laparoscopic enterocele sac excision and vaginal vault suspension fulfils Richardson's requirements for surgical correction of enterocele and provides an anatomic solution to the long-standing surgical dilemma of enterocele.

Introduction

Enteroceles have posed a diagnostic and therapeutic challenge to physicians for centuries [1]. The first formal description of enterocele is attributed to Garengeot in 1736 [2]. In 1885 Thomas described various surgical repairs of enterocele [2]. It was not until 1912 Moschowitz laid the foundation for this type of hernia repair [2]. In 1957, McCall described his technique for culdeplasty [3]. The first description of the abdominal sacrocolpopexy was in 1957 by Arthure and Savage [4].

Since then both fascia lata and synthetic grafts have been described. In 1963, Inmon described the use of iliococcygeus fascia to suspend the vaginal cuff in patients who had inadequate uterosacral ligaments [5]. Sacrospinous ligament colpopexy was described by Richter in 19676 and introduced into the USA by Randall and Nichols in 1971 [6].

In 1998, Schull described the vaginal repair of enterocele by re-suspension to the uterosacral ligament remnants, then followed by site-specific endopelvic fascia defect repair. Of all the procedures listed here, this is the most site-specific. The only drawback has been a ureteric injury rate of up to 11% reported by other groups [7].

A series of 45 women with symptomatic enteroceles who underwent laparoscopic repair is reported using the technique described by Seman et al [8]. The aim of the present prospective observational study was to report the morbidity associated with this surgical procedure and assess the durability of the repair.

Methods

Forty-five women with symptomatic enteroceles underwent laparoscopic enterocele sac excision and vaginal vault suspension at Flinders Endogynaecology, South Australia, Australia during the period of February 2000 to February 2003. The study

was reviewed by the Audit Subcommittee of the Ethics Committee at Flinders Medical Centre. The average age was 66.1 years (48 – 84), average weight 69.3 kg (51–110 kg) and average parity 3.1 (0 – 6).

All of the 45 women had had a previous hysterectomy. A total of 67% of the 45 women had had previous prolapse surgery. Of particular note, 60% had had a previous vaginal repair and 27% a Burch colposuspension (Table 1).

Prior to surgery, each patient was objectively evaluated by means of the pelvic organ prolapse quantification system (POPQ) system [9]. Patients were examined in the dorsal lithotomy position with the examining physician using a speculum to visualise all defects individually. Descent of the prolapse was determined by the Valsalva manoeuvre and confirmed as maximal by the patient. Both the tandem and ordinal POPQ systems were used. All sites were again assessed with the patient anaesthetised by placing traction on the different vaginal segments using Littlewoods. If there was a disparity between preoperative and intraoperative POPQ score, the intraoperative value was taken to be more accurate.

Table 1. Previous surgery.

Surgical procedure	n	%
Hysterectomy	45	100.0
Colporrhaphy	27	60.0
Burch colposuspension	12	26.7
Sacrospinous colpopexy	5	11.1
Marshall-Marchetti-Krantz	2	4.4
Open sacral colpopexy	1	2.0

All patients were examined likewise at the initial postoperative visit and then every 6 months for periods up to 3 years. A postoperative POPQ ordinal score of 0 or 1 indicates a successful operation, that is, the most distal edge of the prolapse is above the hymen. This definition is consistent with recommendations from the National Institutes of Health Terminology Workshop for Researchers in Female Pelvic Floor Dysfunction [10].

Urodynamics were carried out if the woman complained of urinary incontinence, symptoms of voiding dysfunction or if POPQ stages 3 or 4 prolapse was evident on examination (Table 2). This included 26 women in the present series. A total of 50% were found to have mixed urinary incontinence and 27% were found to have coexistent detrusor instability. All women with an unstable bladder were treated conservatively prior to surgery with bladder re-training from a nurse continence advisor and anticholinergics if necessary.

All patients were offered conservative treatment preoperatively and encouraged to continue this postoperatively. This included local oestrogen therapy. There was instruction in Kegel's exercises under the supervision of a specially trained physiotherapist. The patients were also instructed in non-Valsalva voiding and defaecation and offered pessary therapy.

Table 2. Urodynamic assessment (n = 26).

Urodynamic result	n	%
Mixed incontinence	13	500
Detrusor overactivity	7	27.0
Obstructed outflow	4	15.4
Urodynamic stress incontinence	1	3.8
Stable bladder	1	3.8

Surgical procedure

All patients received a preoperative bowel preparation of a phospho-soda buffered saline laxative mixture 1 day prior to surgery. A prophylactic dose of a second generation cephalosporin was given following induction of anaesthesia. Each patient was placed in steep lithotomy using Allen stirrups. Routine thromboprophylaxis was with intraoperative calf stimulators or sequential compression devices. Subcutaneous low molecular weight heparin was given postoperatively until the patient was ambulant.

The first step of the surgical procedure involves excision of the enterocele sac. The enterocele sac is elevated using a vaginal probe. The peritoneum is incised and bladder reflected anteriorly and ureters laterally. A 35-mm McCartney tube is inserted per vaginum to define the enterocele sac. The margins of the sac are healthy pubocervical and rectovaginal fascia. The sac is excised using either monopolar diathermy or a harmonic scalpel.

The second step involves suspending the vault to the uterosacral ligaments in the manner described by Liu [11].

Table 3 details the concomitant procedures used to address other suspension, attachment and fascial defects in a site specific manner.

Results

The mean operating time was 158 mins (range: 60 –240 mins) and mean blood loss was 98 mL (range: 20 – 600 mL). Each woman spent an average of 4.7 days (range: 2 –9) in hospital.

Table 3. Concomitant procedures.

Procedure	n	%
Laparoscopic supralevator repair	32	71.1
Laparoscopic adhesiolysis	28	62,2
Laparoscopic paravaginal repair	14	31.1
Laparoscopic Burch colposuspension	4	8.9
Posterior colporrhaphy	3	6.7
Anterior colporrhaphy	1	2.2

Major complications are defined as bowel injury, ureteric injury, bladder injury, anaesthetic complication, unintended laparotomy and estimated blood loss greater than 1000 mL [12].

The overall major complication rate was 4.4% of cases. An enterotomy occurred at the time of insertion of the primary trochar in a woman who had had previous laparotomies. This procedure was converted to open to repair the damage and she subsequently made a full recovery. This case has not been included in the statistical analysis. There was one case of a vesico-vaginal fistula in a woman who had had several prolapse procedures. The fistula was repaired vaginally and the bladder drained for 3 weeks. She also made a full recovery and had objective cure of her prolapse.

Minor complications included a 12.8% rate of urinary tract infection. Prolonged catheterisation is defined as urine residuals greater than 100 mL by day 7 necessitating catheterisation. This occurred in 10.3% of women. Ileus was observed in 5.1% of women. There were no cases of re-admission.

The women were reviewed at regular 6-monthly intervals for periods up to 3 years. The pre and postoperative objective evaluation by POPQ assessment is

presented in Table 4. Three cases of recurrent enterocele sac formation have been observed and were each assigned a postoperative POPQ value of 2. There is thus a 93% success at 3 years to treat enterocele using this technique of enterocele sac excision and vault suspension to the uterosacral ligaments.

Table 4. Objective evaluation.

POPQ value	Preoperative	Postoperative
0	0	28
1	0	13
2	18	3
3	12	0
4	15	0
Total	45	44

One case of enterotomy completed by open procedure is not included in the postoperative objective evaluation.

Rigorous postoperative evaluation applying strict POPQ definitions has revealed a 11% incidence of symptomatic level II anterior compartment fascial defects. This included five women in which the anterior wall prolapse became symptomatic at an average interval of 11 months from the time of the original surgery.

Discussion

Enterocele is defined by Richardson as a separation of the pubocervical fascia of the anterior vaginal wall from the rectovaginal fascia of the posterior vaginal wall, such that peritoneum is in contact with vaginal mucosa with no intervening fascia [13]. Richardson recommended that the surgical correction of the enterocele defect must

involve reconstruction of the vaginal tube, excision of the redundant peritoneum and vaginal epithelium and re-establishment of the suspension attachment of the reconstructed vaginal tube.

The laparoscopic procedure described herein follows these anatomic principles. The initial step of enterocele sac excision achieves removal of the overstretched vaginal mucosa which is in direct contact with peritoneum. Suturing the edges of the sac achieves apposition of pubocervical fascia to rectovaginal fascia and provides a continuous strong fascia which will give some resistance to downward pressures thereby preventing another enterocele sac forming. The second step involves re-establishing level I support by suspending the neo-vaginal apex to the uterosacral ligaments. Thus continuity is achieved between pubocervical fascia, rectovaginal septum and uterosacral ligament. Their strength lies in their combined integrity [1].

It is noted that moderate to marked vaginal prolapse accompanies the enterocele. It is necessary that the three types of support described by DeLancey [14] – suspension, attachment and fusion – are re-established concurrently with enterocele repair in order to support the vagina.

There were three cases of recurrent enterocele sac formation. The first woman had previously undergone hysterectomy and laparo-vaginal pelvic floor repair. She presented with an enterocele (POPQ stage 3). Following laparoscopic enterocele sac excision and vaginal vault suspension, she represented with another enterocele (POPQ stage 2) 7 months postoperatively. She has subsequently undergone successful laparoscopic mesh sacrocolpopexy. The second woman initially presented with an enterocele (POPQ stage 3). Her past surgery included hysterectomy, Burch colposuspension and vaginal repair. She underwent laparoscopic surgical correction of the enterocele. Fourteen months postoperatively she presented with a recurrent

enterocele and is currently awaiting laparoscopic mesh sacrocolpopexy. The third woman had previously undergone hysterectomy and vaginal repair. She presented with complete vaginal eversion (POPQ stage 4). Twelve months following laparoscopic enterocele sac excision and vaginal vault suspension, she presented with a recurrent enterocele and was thus deemed an anatomic failure. She is also currently awaiting laparoscopic mesh sacrocolpopexy.

The incidence of level II anterior wall fascial defects was noted to be 25%. Half of these became symptomatic and required surgical intervention. This was achieved using autologous tissue grafts to the anterior vaginal wall [15]. There is thus a 11% incidence of symptomatic level II anterior wall fascial defects. There is also a 6.7% incidence of asymptomatic level II posterior wall fascial defects. Surgical intervention has not been required for these posterior wall fascial defects.

Other authors have reported that the anterior compartment is the biggest challenge in pelvic reconstructive surgery [16]. Columbo and Milani reviewed the results of vaginal sacrospinous colpopexy and uterosacral ligament fixation [17]. They found a 21% incidence of subsequent anterior compartment prolapse following this procedure. The 6% rate of anterior compartment prolapse following uterosacral ligament fixation is consistent with the present observations. Logically, the laparoscopic enterocele sac excision and vault suspension is less likely to predispose to future defects in the anterior or posterior wall as it is an anatomic procedure to resuspend the vaginal apex in its natural position rather than distort the vaginal axis by pulling the apex posteriorly, as does the sacrospinous colpopexy.

A future direction for this procedure is the reinforcement of the vaginal apex with autologous tissue graft [18]. This will achieve level I fascial integrity and will provide extra strength to the combined integrity of the pubocervical fascia,

rectovaginal septum and uterosacral ligament. Preliminary results are available for nine patients and look promising.

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CHAPTER 7

Laparoscopic supralevator repair for combined apical and posterior compartment prolapse

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ABSTRACT

Study Objective: To analyze the objective outcome of laparoscopic supralevator repair in the treatment of rectoenterocele using the Pelvic Organ Prolapse Quantification (POPQ) system.

Study Design: Retrospective cohort study 1999-2009 (Canadian Taskforce Classification II-2).

Setting: University hospital in South Australia.

Patients: 166 women with a median age of 63 years (range: 36-89) who underwent laparoscopic supralevator repair for rectoenterocele and treatment of associated conditions over a 10 years period.

Interventions: All patients were assessed with the POPQ scoring system preoperatively and postoperatively at six weeks, six months, annually and biannually.

Measurements and Main Results: The median operating time was 151 minutes (range: 35-390); median blood loss was 50 mL (range: 50-600); and median hospital stay was 4 days (range: 1-14). Four women, two of whom required laparotomy, suffered a major complication. Ten women (6%) needed day surgery to treat vaginal granulations or suture exposure. With a median follow-up time of 45 months (interquartile range: 16-67) the overall objective success rate was 63% according to National Institute of Health (NIH) criteria. The median time to failure was 24 months. Of 61 objective failures, 23 required further prolapse surgery, representing a 14% reoperation rate.

Conclusion: Laparoscopic supralevator repair is a safe and effective procedure for the treatment of rectoenterocele.

Introduction

Before the advent of laparoscopic pelvic floor repair, only six gynecological procedures were performed for posterior compartment prolapse [1-3]. Four were transvaginal [1, 2] and two were open abdominal procedures [3]. The transvaginal options included posterior colporrhaphy (midline plication), site specific defect repair [2], placement of a graft, and colpocleisis. These mainly addressed defects in the lower two thirds of the posterior vaginal wall. Associated apical support defects were addressed by suspension to either the uterosacral or sacrospinous ligaments [4, 5]. Abdominal options were mesh sacral colpopexy and the Zacharin abdominoperineal technique [3]. Zacharin's procedure treated defects at the apex and upper posterior wall, while mesh sacral colpopexy treated the same defects but, when configured in a "y" shape, covered the anterior fornix as well [6]. Colporrhaphy was mostly used for primary repair of a rectocele. Posterior compartment recurrences were often associated with apical defects and these were usually treated with an abdominal approach.

The development of a laparoscopic approach to apical and posterior defects by Lyons and Winer [7], Paraiso et al.[8], and Rosen and Lam [9] constituted a radical change. Lam's procedure was first published in 1997 for the treatment of enterocele occurring after hysterectomy [9]. It introduced an attractive and clinically important alternative to mesh procedures. We renamed it supralevator repair, when we published our initial experience in 2003 [10]. The current paper is based on a retrospective review of a decade of experience with laparoscopic supralevator repair. It analyzes the objective outcome of this repair for the treatment of rectoenterocele and examines its place among prolapse procedures.

Methods and Surgical Technique

Since 1999, clinical data have been collected for all women undergoing laparoscopic pelvic floor repair at Flinders Medical Centre, a tertiary university hospital in South Australia. Data include pre- and postoperative POPQ assessments [11] at six weeks, six months, one year, then bi-annually, as well as subjective satisfaction and any need for further treatment. POPQ assessments aimed to reveal the patient's maximum bulge by examination in supine position and standing when necessary. Most often these assessments both before and after surgery were made by the operating gynecologist. The study was approved by the Flinders Medical Centre Ethical Committee as an audit activity.

For the operation the patient is placed in the dorsal lithotomy position and the bladder drained. After establishing a pneumoperitoneum using either a Veress needle or open modified Hasson technique, ports are placed according to the surgeon's need to achieve an ergonomic suturing technique. However, a 12 mm suprapubic port is required if an anterior paravaginal repair is needed. Surgery proceeds with the patient in steep Trendelenburg position. The operator and main assistant are on opposite sides of the patient, each with their own video display, and another assistant manipulates the rectal and vaginal probes from below. Adhesiolysis is performed as required and peritoneal incisions are made to display the ureters. Reusable probes, either end-to-end anastomic (EEA^{TM}) sizers or Cook vaginal and rectal probes, depending on availability, are placed in the rectum and vagina to facilitate safe dissection of the rectovaginal space from above.

The supralevator repair begins by accessing the posterior compartment via an arched peritoneal incision, starting at the vaginal apex and ending medial to the uterosacral folds below. To do so, the vaginal probe is firmly pushed upward from

below and the posterior peritoneum over the vault is pulled down by an assistant and incised in the midline with monopolar scissors. Carefully identifying the ureters, the incision is extended laterally to the sacral attachements of the uterosacral ligaments. With the rectal probe moving the rectum away from the plane of dissection, the rectovaginal space is opened with blunt and sharp dissection caudally to the perineal body and laterally to the levators ani.

The first suture (size 0 Ethibond, Ethicon) is placed just above the perineal body incorporating first the left levator muscle edge, then 3 successive bites in the vagina (avoiding penetration) and finally the right levator muscle. A ladder of 6 to 8 permanent, braided supporting sutures is created, moving upwards to end 1 cm below the cervix or vault scar. For each of these, 5 tissue bites are taken one in the left lateral side wall, three in the posterior vagina, and one in the right lateral side wall. An extracorporeal suturing technique allows the first two throws of the knot to achieve exact tension, with two further throws to lock the knot. The suture loops are tied loosely avoiding approximation of the levators and lateral anchor points which tends to cause postoperative pain and dyspareunia. Rectal integrity is confirmed with a bubble test after the first suture is inserted. Subsequent sutures are placed 5-10 mm apart in an upward direction, restoring the natural vaginal axis toward the midsacrum, again avoiding tight approximation. Finally, the uterosacral ligaments are attached to the vault with separate 0 Ethibond sutures for the uterosacral colpopexy or hysteropexy, if the woman wants to preserve her uterus. These uppermost sutures are tensioned to elevate the apex to about 10 cm above the hymen.

In the original procedure an associated enterocele was dealt with by purse string reduction [9]. However, to improve durability of the procedure we altered it by excising the enterocele sac before performing uterosacral colpopexy. The presence of

an enterocele sac is demonstrated if a vaginal probe can elevate the upper vagina to above the posterior border of the empty bladder. Sac excision is facilitated with a McCartney tube [12]. The vaginal edges, including the rectovaginal fascia and pubocervical fascia, are sutured together and uterosacral colpopexy is performed by attaching the presacral remnants of the uterosacral ligaments to the ipsilateral posterior fornix. When the pubocervical and rectovaginal fasciae are deficient or absent, the excised sac is attached to the suture line as a patch to give extra support by inducing fibrosis and covered with adjacent peritoneum to prevent adherence of bowel. Cystoscopy is performed to confirm bilateral ureteral patency and exclude injury to the bladder. Any residual defect in the lower third of the posterior wall is addressed by colpoperineorrhaphy up to the lowest laparoscopic suture.

Concomitant procedures, such as laparoscopic paravaginal repair, are performed as clinically indicated.

PASW 18 Statistics was used for data analysis.

Results

From 1999 to 2009, 166 laparoscopic supralevator repairs were performed by several trainee and consultant gynecologists to correct rectoenterocele. Follow-up data are missing for only 3 women (2%). The patients' median age was 63 years (range: 36 – 89), median weight 71 kg (range: 48 – 120) and median parity 3 (range: 0 – 7). Prior surgery included hysterectomy in 126 (76%), anterior repair in 52 (31%) and posterior repair in 39 women (23%). Twenty-nine (17%) had had other procedures, including continence surgery, Manchester repair and ventrosuspension. Preoperatively, 67% of women had POPQ Stage 2 prolapse, 22% had Stage 3 and 11% Stage 4 prolapse.

The majority of patients had concomitant procedures, virtually all of which were conducted laparoscopically. The commonest were uterosacral suspension (n = 135; 81%), anterior compartment paravaginal repair (n = 60; 36%), and treatment of enterocele (n = 57; 34%). Only 14 (0.8%) of the associated procedures were conducted vaginally. After the placement of supralevator sutures, 57 women required concomitant treatment for a residual enterocele sac. Purse string reduction was used for the first 10 women, and sac excision for the remaining 47. In all but one of these the excised sac was sutured as a free-tissue graft over the vault and covered with peritoneum. Of the 10 women treated with purse-string reduction, 4 had a subsequent failure compared with only 2 of 47 treated by sac excision.

The duration of the supralevator repair itself was not specifically recorded and the mean operating time of 155 minutes was largely skewed because of the concomitant procedures (median: 151 minutes; range: 35 – 390); average estimated blood loss was 95 mL (median: 50 mL; range: 50 – 600) and the median postoperative hospital stay was 4 days (range: 1 – 14).

There were five operative complications, defined as anesthetic complications, blood loss in excess of 1,000 mL, unintended injuries or need for open surgery, occurring in four women. Two of them required laparotomy. Three of the complications were bladder injuries associated with paravaginal repair. In another case, early in the learning curve, the rectum was perforated and the ureters inadvertently ligated. In addition, three women complained of a severe burning pain in the rectum in the early post-operative period due to excessive tension on one or more of the sutures. Transvaginal removal promptly resolved the problem.

Median follow-up was 45 months (interquartile range: 16 to 67 months). The success rate according to National Institutes of Health (NIH) criteria [13] was 63%.

One in three women had a recurrence (i.e. POPQ stage 2 or greater prolapse in any compartment) within three years of surgery. Failures subdivided by compartment are shown in Table 1. Median time to failure was 24 months and median time to re-operation 31 months. Of the 61 failures 16 occurred within 1 year, 42 within the first 3 years and 9 after 5 years. Vault recurrences were less frequent than recurrences in the anterior or posterior compartments, but tended to occur earlier. Of the 61 women with a recurrence, 13 were asymptomatic, 23 had further surgery, 3 were treated with a pessary, and 22 had no later follow-up.

Vaginal suture erosion or granulation formation occurred in 28 women (17%). Median time to the first diagnosis of erosion was 24 months with a range up to 10 years. Management included use of vaginal estrogens, silver nitrate cautery to granulations and excision of the exposed suture, which required general anesthesia in 10 women. The removal of eroded suture material did not compromise the durability of the repair.

Table 1. Failure rates and the compartments involved in relation to the duration of follow-up.

Duration of follow-up	Number of patients	Number of failures	Compartment involved *			
			Vault	Anterior	Posterior	Not documented
< 1 year	35	4	3	2	1	0
1-3 years	39	18	3	9	5	2
3-5 years	44	16	4	9	3	4
> 5 years	45	23	3	17	10	1
Total	163	61	13	37	19	7

* Some failures involved several compartments.

Discussion

Supralevator repair is best conceptualized as a laparoscopic derivative of Zacharin's abdominoperineal repair of post-hysterectomy enterocele [3]. The decision to perform this procedure needs to consider many important factors, such as the surgeon's laparoscopic skills, patient preferences, past pelvic floor surgery, the presence of vaginal shortening, desire to maintain coital function, presence of pelvic adhesions, need for concomitant surgery, and fitness for bowel preparation and general anesthesia.

The ideal situation is one in which a high rectocele occurs after hysterectomy combined with anterior and posterior vaginal repair. Prolapse of the upper posterior wall is difficult to treat by midline plication without causing vaginal narrowing and shortening. Transvaginal mesh kits with apical support and mesh sacral colpopexy

are current methods to try to overcome this problem The major advantages of the supralevator repair are its ability to confer a high cure rate for prolapse and to maintain normal vaginal length and diameter. It is a native tissue repair that leaves the vaginal tube intact, unless an enterocele sac requires excision, which was the case in 35% of our patients.

The fact that many postoperative POPQ assessments were made by the operating gynecologist, although clinically commendable, may be perceived as a weakness of our study. Nevertheless, the formal assessments indicate that supralevator repair is an effective option for the treatment of apical and posterior compartment prolapse. It can be a useful alternative to mesh sacral colpopexy in some situations. For example, when mesh sacral colpopexy is technically difficult because access to the sacral promontory is limited due to pathology, such as an adherent bowel or aberrant vessels. It can be used when sacral colpopexy has failed because the mesh has lost its attachment at the vaginal end. Supralevator repair also avoids the serious complications that can occur with mesh sacral colpopexy, including mesh erosion [14] and exposure [15], bowel adherence to the mesh [16], discitis [17], and osteomyelitis [17, 18]. Complications associated with mesh placement have recently been the subject of a renewed warning by the Food and Drug Administration [19].

Apical support is readily achieved with concomitant uterosacral colpopexy which is a straightforward procedure to master. If present, an enterocele sac is best excised instead of being treated by purse-string reduction. Of the 10 women treated with purse-string reduction 4 had a subsequent failure compared with only 2 of the 47 treated by sac excision.

Suture erosion into the vagina and associated granulation occurred in 17% of women. Although high, this rate is substantially less than that seen after transvaginal colpopexy with permanent braided sutures [20]. This complication can present some years after surgery and is usually amenable to outpatient excision and/or cautery with silver nitrate. Recurrent granulations are best treated by transvaginal excision of the underlying suture, which does not appear to compromise the durability of the repair, presumably because support is maintained by adjacent fibrosis. It is possible that the use of a permanent or delayed absorbable monofilamentous suture may further reduce the frequency of this complication. However, a braided suture is technically easier to manipulate and tie in the rectovaginal space. Severe postoperative rectal pain, due to excessive tension in one or more sutures, is an uncommon occurrence. The site of the offending suture is easily identified where digital rectal examination replicates the symptom. The suture is readily removed under general anesthesia through a small vaginal incision.

Limitations to the wide adoption of laparoscopic supralevator repair are the need for technical skills in laparoscopic dissection and suturing, and gynecologists' tendency to favor vaginal approaches to prolapse surgery. In recent years, transvaginal mesh kits have surged in popularity, as they are technically simpler and quicker than either supralevator repair or mesh sacral colpopexy [21]. However, surgeons who have developed the dissection and suturing skills required for laparoscopic mesh sacral colpopexy would find the supralevator repair technically similar. Another factor is the rather lengthy operating time. We did not time the duration of the repair itself and in a third of our patients adhesiolysis added more than an hour to its duration. Overall, however, the operating time is similar to that reported for laparoscopic mesh sacral colpopexy [22].

To deal with primary posterior prolapse our current preference is to use fascial posterior colporrhaphy with incorporation of the distal rectovaginal fascia. Low posterior wall recurrences are treated using porcine graft (Surgisis, Cook Surgical, Bloomington, IN) augmented repair [23]. High posterior wall recurrences or combined posterior and apical defects are treated with laparoscopic supralevator repair or mesh sacral colpopexy. Apical and posterior recurrences after supralevator repair are treated with laparoscopic mesh sacral colpopexy or an apical and posterior mesh kit if the laparoscopic route is contraindicated. Low posterior recurrences after supralevator repair are treated with low colpoperineorrhaphy or site-specific repair taken up to the level of intact suture support. The treatment of recurrences can be difficult due to fibrosis.

Conclusion

Laparoscopic pelvic floor repair received widespread attention in the late 1990s and early 2000s, but its popularity waned after the introduction of transvaginal mesh kits. Long term outcome data are scarce for most pelvic floor procedures and the current study presents the only long-term results published for laparoscopic supralevator repair. For gynecologists with the necessary laparoscopic dissection and suturing skills, the supralevator repair is an attractive alternative to mesh procedures as it preserves vaginal length and caliber with little long-term morbidity.

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CHAPTER 8

Effect of uterine preservation on the outcome of laparoscopic uterosacral suspension

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ABSTRACT

STUDY OBJECTIVE: To compare the objective outcome of laparoscopic uterosacral hysteropexy with that of hysterectomy combined with laparoscopic uterosacral colpopexy.

STUDY DESIGN: Retrospective cohort study 1999-2010 (Canadian Taskforce Classification II-2).

SETTING: University hospital in South Australia.

PATIENTS: Women with uterovaginal prolapse who had undergone laparoscopic uterosacral hysteropexy (n=104) or laparovaginal hysterectomy with uterosacral colpopexy (n=160). Apical suspension procedures were subdivided into 'prophylactic' (POPQ Stage I apical descent with Stage II or greater prolapse in an adjacent compartment) and 'therapeutic' (POPQ Stage II or greater apical descent with or without adjacent compartment prolapse).

INTERVENTIONS: All patients were assessed with POPQ scoring preoperatively and postoperatively at 6 weeks, 6 months, yearly and then biannually. Recurrence of bulge symptoms and need for re-treatment were recorded.

MEASUREMENTS AND MAIN RESULTS: Demographics, preoperative degrees of prolapse and proportions of prophylactic and therapeutic procedures were similar in both groups. With a median follow-up of 2.5 years, objective success rates (POPQ stage <2 in all compartments) for uterosacral hysteropexy were 53% for prophylactic and 41% for therapeutic procedures. For hysterectomy with uterosacral colpopexy they were 66% for prophylactic and 59% for therapeutic procedures. Re-operation rates overall were 28% for hysteropexy and 21% for hysterectomy with colpopexy. Failures at the apex specifically were 27% for hysteropexy and 11% for hysterectomy with colpopexy ($p < 0.02$).

CONCLUSION: Hysterectomy with laparoscopic uterosacral colpopexy produced better objective success rates than laparoscopic uterosacral hysteropexy, but re-operation rates were not significantly different.

Introduction

Surgical treatment of uterovaginal prolapse has traditionally been vaginal hysterectomy and repair combined with some form of apical suspension [1]. In the past two decades, several authors have challenged this paradigm because of the alleged merits of uterine preservation. These include preservation of fertility [2], maintenance of anatomical integrity [3], reductions in operating time, blood loss and hospital stay [4], and better body image, confidence, self-esteem and sexuality [5]. Several authors also claim that suspension of the uterus is as effective as its removal for correcting uterovaginal prolapse[2, 6-9], with some arguing that hysterectomy should no longer be the logical first choice [4, 10]. However, there may also be reasons for recommending hysterectomy during prolapse surgery, such as abnormal uterine bleeding or high grade cervical cytology.

Techniques for hysteropexy can be divided into vaginal and abdominal (open or laparoscopic) approaches with little evidence as to which provides the best results [11-14]. One small randomized trial comparing vaginal hysterectomy to sacrospinous hysteropexy showed inferior anatomical outcomes at 12 months with uterine preservation [15]. In a recent survey of Australian and New Zealand gynaecologists, laparoscopic uterosacral hysteropexy was the procedure most frequently chosen when dealing with women wanting to preserve fertility [16]. From a technical perspective it is probably the easiest of all laparoscopic pelvic floor procedures. Despite the relative simplicity and apparent popularity of this procedure, there are only a few small series reporting on outcomes of this repair [17-22], and there are no controlled trials comparing it with hysterectomy.

This study compares a cohort of women who underwent laparoscopic uterosacral suture hysteropexy with those who had a uterosacral colpopexy at the time of laparovaginal hysterectomy. The cohorts are further divided into 'therapeutic' and 'prophylactic' groups depending on the degree of apical descent.

Methods and Surgical Technique

Since 1999, clinical data have been collected for all women undergoing laparoscopic pelvic floor repair at Flinders Medical Centre, a tertiary university hospital in South Australia. Data include POPQ assessments [23] preoperatively and at six weeks, six months, one year, then bi-annually after surgery, and any need for subsequent treatments.

The technique of laparoscopic uterosacral hysteropexy is based on that of Lyons and colleagues [24] and aims to reattach the uterosacral ligaments to the posterior cervix and maintain the normal vaginal axis and caliber. Briefly, it involves a four-puncture videolaparoscopic approach to the pouch of Douglas. The uterus is anteverted to reveal the uterosacral peritoneal folds and a 2 cm peritoneal incision is made cranial to these folds, medial and parallel to each ureter. This allows exploration of the presacral space to identify the uterosacral ligament. The ligament is grasped and put on tension by pulling it toward the cervix, causing its fibres to stand out from the sacral vertebrae. Each uterosacral ligament is sutured to the cervix with one permanent braided suture (Ethibond size 0 on a CT-2 needle; Ethicon, NJ) on each side. The needle is first driven horizontally from the insertion of the left uterosacral ligament deep into the cervical stroma to exit in the mid-cervix. A second bite is taken to the right of that needle exit

passing deep into the posterior cervix and exiting at the insertion of the right uterosacral ligament. Once the suture is pulled through, two further passes are made in the presacral part of the right ligament in a clockwise fashion taking care to avoid the ureter. For the left uterosacral ligament the procedure begins in the ligament and proceeds to the cervix ideally overlapping the first suture. For a right-hand dominant surgeon, all sutures are taken in a clockwise direction. When dense adhesions seriously limit access to one side, unilateral suspension is performed with one or two sutures on the adhesion-free side.

For colpopexy following hysterectomy, the closed vault is sharply anteverted with a solid probe. Sutures are inserted in a similar sequence as described above and placed about one cm posterior and parallel to the line of vault closure.

Suture tensioning is critical and should aim to elevate the cervix or vault 8 to 10 cm above the hymenal remnant and allow at least a 4-5 cm posterior gap to avoid rectal compression. If a suture is left isolated ('bowstrung'), peritoneum is closed over any lateral gap to prevent small bowel from becoming entrapped. The procedure concludes with cystoscopy to confirm bilateral ureteric patency.

For the purpose of this study a distinction was made between 'therapeutic' and 'prophylactic' level one support procedures. The laparoscopic suspension is considered to be 'therapeutic' if used to correct apical prolapse of POPQ stage 2 to 4, and 'prophylactic' when used to address apical descent of POPQ stage 1 together with repair of an associated prolapse of POPQ stage 2 or more in another compartment. All women who underwent hysterectomy had a laparovaginal technique. The degree of laparoscopic assistance varied from minimal (e.g., diathermy to achieve vault haemostasis) to complete (i.e., total laparoscopic hysterectomy).

The study was approved as an audit activity by our institutional ethics committee. PASW 18 Statistics was used for data analysis. Continuous data were compared with Mann-Whitney tests and categorical data with chi-square or Fisher exact tests and confidence interval (CI) analyses as indicated. Statistical significance was set at $p < 0.05$.

Results

From 1999 to 2010, 104 hysteropexies and 160 hysterectomies with concurrent colpopexy were performed by several trainee and consultant gynaecologists. There were 141 (88%) total laparoscopic hysterectomies; the remainder were laparoscopically assisted vaginal hysterectomies. Table 1 records demographics, past surgical procedures, preoperative POPQ stages and the pelvic compartments affected.

Table 2 records operative details, concomitant procedures and duration of follow-up. The most common additional surgery involved the anterior compartment (Table 2). Median operating time with all associated procedures was 120 minutes (range: 30-255) in the hysteropexy group and 140 minutes (range: 80-300) in the hysterectomy group ($p < 0.01$). Median estimated blood loss was 50 mL, ranging up to 750 mL in the hysteropexy group and up to 1,000 mL in the hysterectomy group, including that due to the associated procedures. The median postoperative stay was four days. There was only one major intra-operative complication (cystotomy during paravaginal repair) and one post-operative complication (small bowel entrapment requiring laparotomy to treat bowel obstruction). There were no cases of ureteric obstruction or impingement.

Table 1. Characteristics of women who underwent laparoscopic uterosacral hysteropexy or laparoscopic uterosacral colpopexy with concurrent hysterectomy.*

Characteristic	Hysteropexy (n = 104)		Colpopexy (n = 160)	
Age in years (median; range)	58 (27 – 87)		59 (37 – 90)	
Weight (median; range)	69 (52 – 110)		68 (40 – 115)	
Parity (median; range)	3 (0 – 7)		3 (0 – 9)	
Previous vaginal repair (n)				
Anterior	4		1	
Posterior	4		1	
Preoperative POPQ stage (n; %)				
1	1	1.0	5	3.1
2	78	75.0	122	76.3
3	21	20.2	30	18.8
4	4	3.8	3	1.9
Compartment involved (n; %)				
Apical only	10	9.6	22	13.8
Apical + anterior	19	18.3	33	20.6
Apical + posterior	8	7.7	10	6.3
Anterior only **	49	47.1	75	46.9
Posterior only **	4	3.8	2	1.3
Global	14	13.5	18	11.3
Compartment involved (n; %)				
Apical	51	49.0	83	51.9
Anterior	82	78.8	126	78.7
Posterior	28	26.9	30	18.8

* None of these characteristics differed significantly between the two groups.
** Defined as prophylactic hysteropexy or colpopexy.

Table 2. Operative characteristics and duration of follow-up of women undergoing laparoscopic uterosacral hysteropexy or laparoscopic uterosacral colpopexy with concurrent hysterectomy.

Characteristic	Hysteropexy (n = 104)		Colpopexy (n = 160)		P value *
Purpose of the apical procedure (n; %)					
Prophylactic	53	51.0	77	48.1	ns
Therapeutic	51	49.0	83	51.9	ns
Concomitant procedures (n; %)					
Laparoscopic paravaginal repair	72	69.2	108	67.5	.025
Anterior repair	18	17.3	9	5.6	.004
Posterior repair	13	12.5	16	10.0	ns
Operating time (min: median; range)	120 (30-255)		140 (80-300)		.002
Blood loss (mL: median; range)	50 (30-750)		50 (30-1000)		ns
Duration of follow-up (months)					
Median	34.4		21.7		.013
Range	1.5 – 146		1.5 – 133		
Interquartile range	8.2 – 74.2		11.7 – 36.0		

* ns: not significant.

Median follow-up was one year longer for the hysteropexy group than for the colpopexy group (Table 2). There was a clear trend for failures, as defined by the NIH group in 2001,[25] i.e., descent to POPQ stage 2 in any compartment, to be more common in the hysteropexy group than in the colpopexy group (Table 3). The trend remained in various subanalyses for patients with similar duration of follow-up, but failed to reach statistical significance because of small numbers. Overall, there were 55 failures in the

hysteropexy group (52.9%; 95% CI: 43.3 - 62.5%) and 60 in the colpopexy group (37.5%; 95% CI: 30.0 - 45.0%), a difference that is statistically significant ($p < 0.02$).

There was no statistical difference in failure rates between therapeutic (41%; 95% CI: 30.3 - 52.3%) and prophylactic (34%; 95% CI: 23.4 - 45.5%) procedures in the colpopexy group or in the hysteropexy group (59%; 95% CI: 44.2 - 72.4 %-versus 47%; 95% CI: 33.3 - 61.4%), although failures tended to be more common with therapeutic than with prophylactic procedures. In women with apical prolapse of POPQ stage 2 or more hysteropexy was more likely to fail than colpopexy (Table 4). As shown in Table 4, failures in any compartment were 59% for hysteropexy versus 41% for colpopexy ($p < 0.05$) and for the apex specifically 27% versus 11% ($p < 0.02$).

Failures in the hysteropexy group were mostly associated with cervical elongation, some with failure of the sutures and one with uterine enlargement. The latter underwent repeat hysteropexy which failed again and subsequently required hysterectomy and sacrospinous colpopexy.

Overall, 29 women (28%; 95% CI: 19.3% to 36.5%) in the hysteropexy group later underwent further prolapse surgery (8 of them on more than one occasion) compared with 33 (21%; 95% CI: 14.4% to 26.9%)in the colpopexy group. Of these women, 21 in each group required re-operation for an apical recurrence; a difference that is not statistically significant (Table 5). Thirteen women in the hysteropexy group (13%; 95% CI: 6.1% to 18.9%)eventually underwent hysterectomy,usually technically difficult due to the presence of pericervical adhesions, cervical elongation and restricted descent of the uterus.In our hysteropexy cohort only 13 women were under the age of 42 and one

had a subsequent pregnancy, which proceeded uneventfully. Examination shortly after delivery by caesarean section showed normal support in all compartments.

Table 3. Failure rates of laparoscopic uterosacral hysteropexy or laparoscopic uterosacral colpopexy with concurrent hysterectomy.

Type of failure	Hysteropexy (n = 104)		Colpopexy (n = 160)		P value *
Failure according to NIH criteria (n; %)					
Within 1 year	18	17.3	19	11.9	ns
Within 3 years	41	39.4	49	30.6	ns
Total	55	52.9	60	37.5	.019
Site of initial failure (n; %)					
Apical	21	20.2	14	8.8	.013
Anterior	30	28.8	35	21.9	ns
Posterior	21	20.2	27	16.9	ns
Not documented	2		3		
Time to failure in months (median; range)					
	18.0 (1.4 - 146)		14.9 (1.4 - 117)		ns
Re-operation rate (n; %)	29	27.9	33	20.6	ns
Apical failure at any time (in months) during follow-up **					
Failures (n; %)	25	24.0	21	13.1	.034
Months (median; range)	16.7 (2.8 - 96.2)		9.2 (1.4 - 82.4)		ns

* ns: not significant.

** Some of these failures occurred after previous failure in another compartment.

Table 4. Failure rates of laparoscopic uterosacral hysteropexy or laparoscopic uterosacral colpopexy with concurrent hysterectomy performed as a prophylactic or therapeutic procedure.

Type of failure	Hysteropexy		Colpopexy		P value
	n	%	n	%	
Prophylactic procedures *	53		77		
Any failure (NIH)	25	47.2	26	33.8	.124
Apical failure	11	20.8	12	15.6	.448
Therapeutic procedures	51		83		
Any failure (NIH)	30	58.8	34	41.0	.044
Apical failure	14	27.4	9	10.8	.013

* Prophylactic procedures addressed apical descent of POPQ stage 1 together with repair of an associated POPQ stage 2 to 4 prolapse in another compartment.

In the hysterectomy with colpopexy group 21 women (13%; 95% CI: 7.9 - 18.4%) had a subsequent procedure to resuspend the vault (Table 5).

Discussion

Three recent surveys on the surgical management of prolapse have documented a trend toward uterine preservation [16, 26, 27]. There are many surgical options for hysteropexy and no recognized gold standard [11, 12, 28]. Laparoscopic hysteropexy is apparently the most popular choice for gynaecologists in Australia and New Zealand [16] and probably the easiest laparoscopic pelvic floor repair procedure. The current cohort study allowed analysis of objective outcomes of laparoscopic uterosacral hysteropexy at a median follow-up of nearly 3 years. A separate cohort of women

treated by the same gynecologists in the same institution was identified in whom the uterus was removed. While there are undoubtedly inherent biases in the comparison of these two groups, interesting observations can be made.

Table 5. Number of women requiring re-operation for apical failure after hysteropexy or hysterectomy with colpopexy.

Type of intervention	Number	
Hysteropexy group		21
Repeat hysteropexy	8	
Vaginal hysterectomy	10	
Laparoscopic hysterectomy with		
Uterosacral colpopexy	1	
Mesh sacral colpopexy	2	
Hysterectomy with colpopexy group		21
Repeat uterosacral colpopexy	14	
Mesh sacral colpopexy	5	
Vaginal vault suspension	2	

In our patients we made the distinction between prophylactic and therapeutic procedures. The intention in the prophylactic procedure is to reinforce the support of a uterus or a vaginal vault that has at most POPQ stage 1 descent. By contrast, the intention of the therapeutic procedure is to resuspend an apex that has descended to POPQ stage 2 or more. As POPQ stage 1 encompasses potentially 7 cm of descent for

the cervix before reaching stage 2 [25], many women in the ‘prophylactic’ group had significant descent combined with adjacent defects and were felt to need apical repair to ensure an overall success [29].

There are several limitations to this study. Firstly, the choice of procedure (hysteropexy versus hysterectomy with colpopexy) was not bias-free as it was based on patient and surgeon preferences. In addition, over time, hysterectomy with colpopexy tended to be favored, resulting in a shorter median duration of follow-up in this group than in the hysteropexy group. However, demographics and degree of prolapse were similar in both groups, as were the proportions of prophylactic and therapeutic procedures. Also, when accounting for the difference in duration of follow-up, the results of hysterectomy with colpopexy remained superior to those of hysteropexy. Secondly, postoperative assessors were not blinded to the intervention, nor could they be. However, several assessors were involved in most cases because of the duration of follow-up and the characteristics of a teaching hospital. Thirdly, subjective follow-up data were not recorded in a systematic manner throughout. Nowadays, a number of validated tools are available for this purpose, but they cannot be applied retrospectively.

Not surprisingly, both procedures were more successful when used for prophylactic than for therapeutic purposes, but the differences were not marked enough to be statistically significant in our series. This may reflect the relatively small numbers within groups. At a median follow-up of 2.5 years prophylactic hysteropexy had an objective success rate of 53% while therapeutic hysteropexy had a success rate of 41%. The objective success of hysterectomy with uterosacral colpopexy was 66% for

prophylactic and 59% for therapeutic procedures, with the latter giving even slightly better results than prophylactic hysteropexy (53%).

We have the impression that cervical elongation may be a significant cause of failure of hysteropexy as the uterine body remains well supported whilst the elongating cervix 'drags' the adjacent vaginal walls down [30]. Procedures which suspend by pulling on the back of the cervix tend to promote uterine retroversion and subsequent cervical elongation, whereas those which push the anterior part of the cervix upwards encourage anteversion. Hysteropexy techniques that tend to promote retroversion include laparoscopic uterosacral suspension, laparoscopic mesh sacral hysteropexy when mesh is attached to the back of the cervix, and transvaginal sacrospinous fixation. Shortening the round ligaments by ventrosuspension may limit this retroverting effect, but whether this reduces the failure rate of hysteropexy remains to be determined.

Anteverting techniques of hysteropexy include apical mesh kits which attach to the front of the cervix, Manchester repair, laparoscopic mesh sacral hysteropexy when mesh is wrapped around the front of the cervix [13], and permanent suture fixation of the right round ligament. The latter technique, described by Hsieh in 2011 [11], may be the only ventrosuspension method that effectively resuspends the uterus. Previously, ventrosuspension had a limited role as uterine prolapse often recurred shortly after surgery [27, 31]. In our opinion, round ligament shortening is probably only of benefit when performed in addition to a retroverting hysteropexy technique.

Other causes of hysteropexy failure are failure to achieve robust anchorage of the suture at either end, excessive tension causing suture avulsion from an anchor point, and failure to treat coexisting defects in an adjacent compartment. The latter problem is

particularly pertinent as hysteropexy tends to straighten the anterior and posterior vaginal walls, masking coexisting vaginal prolapse and creating the false impression that no further treatment is needed. It is important to carefully plan the sequence of repairs, as anterior vaginal repair in particular can be difficult after vault suspension.

In the hysteropexy group, most recurrences were treated by hysterectomy, revision of apical suspension and repair of associated anterior or posterior compartment defects. Intra-operatively, we observed that all uteri were retroverted and mostly difficult to remove because of well-maintained uterine support and the presence of adhesions around an elongated cervix.

While a randomized controlled trial could deal with the biases discussed above, the problems of conducting such a trial are considerable. Not only lack many professionals the equipoise to justify participation in such a trial [16, 26], patient preferences and relative contraindications to uterine preservation would make recruitment challenging. Patients would also need long-term follow-up for cure rates, delayed complications and difficulties treating recurrences. Thus, carefully conducted observational studies, such as ours, will remain essential.

From our study we conclude that for uterovaginal prolapse of POPQ stage 2 or more, hysterectomy with concomitant vault suspension provides a more durable result than hysteropexy. For women in whom fertility preservation is paramount or with modest apical descent associated with anterior and/or posterior compartment prolapse, laparoscopic uterosacral hysteropexy provides a useful alternative. In these circumstances, anteverting the uterus by round ligament plication may perhaps reduce the likelihood of cervical elongation and the need for subsequent intervention.

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CHAPTER 9

Use of Surgisis for treatment of anterior and posterior vaginal prolapse

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ABSTRACT

Aim: To evaluate the anatomical success and complication rate of Surgisis in the repair of anterior and posterior vaginal wall prolapse.

Methods: A retrospective review of 65 consecutive Surgisis prolapse repairs, involving the anterior and/or posterior compartment, performed between 2003 and 2009, including their objective and subjective success rates using the pelvic organ prolapse quantification (POPQ) system.

Results: The subjective success rate (no symptoms and no bulge beyond the hymen) was 92% and the overall objective success rate (no subsequent prolapse in any compartment) was 66% (43 of 65). The overall re-operation rate for de novo and recurrent prolapse was 7.7% with 3 women undergoing repeat surgery at the same site (anterior compartment). No long-term complications occurred.

Conclusions: Surgisis has a definite role in the surgical treatment of prolapse. It may decrease recurrences seen with native tissue repair and long-term complications of synthetic mesh. Its use in posterior compartment repair in particular is promising.

Introduction

The satisfactory surgical treatment of vaginal prolapse continues to elude gynaecologists, as evidenced by reports of failure rates ranging from 30% to 70% and a re-operation rate of 30% [1-3]. Permanent prostheses and mesh kits have been introduced in an attempt to improve these figures, but their use has been tempered by complications and long-term sequelae related to the techniques and materials used [4,5].

Jia *et al.* [5] reviewed rates of objective failure and re-operation for failures and mesh excision of absorbable, biological, and non-absorbable mesh in 3,000 women. For the anterior compartment, the objective failure rates for no mesh, absorbable mesh, biological grafts, and permanent mesh were, respectively, 29%, 23%, 18%, and 9%. However, synthetic mesh was associated with a re-operation rate of 6.6%. Biological grafts had a re-operation rate of 3% and surgery for mesh excision occurred in another 2.6%. For the posterior compartment, there were insufficient data to determine success rates. In comparison to native tissue repair, there was a trend toward lower failure rates with absorbable and non-absorbable synthetic meshes, but higher failure rates with biological grafts. However, there is much heterogeneity in biological grafts and most studies evaluated by Jia *et al.* [5] used a porcine dermal graft.

Surgisis (Cook Surgical, Bloomington, IN) is a biological graft extracted from porcine small intestinal submucosa. In comparison to porcine dermal grafts, Surgisis has a higher collagen content, is acellular, and not cross-linked. In vivo, these characteristics result in graft resorption and replacement by host connective tissue. This may reduce long-term complications, but concerns have been raised about the durability of the resultant repair [6]. To date, very few studies have been

published on the use of Surgisis for vaginal prolapse repair [7-10]. The aim of this study was to determine the success and complication rates of Surgisis in the treatment of anterior and posterior vaginal prolapse over a six year period.

Surgical Procedures and Methods

From 2003 to 2009, 65 women with pelvic organ prolapse have been treated with Surgisis xenograft by four surgeons at the Flinders Urogynaecology Unit. Women treated with Surgisis were those considered at high risk of recurrence from traditional colporrhaphy or who had a recurrence after previous surgery. The treatments involved the anterior, apical or posterior compartment, singularly or in combination, with the surgical technique adapted accordingly. Concomitant procedures, such as hysterectomy and urethral sling, were performed as clinically indicated.

For anterior repair, a midline vaginal incision is made from the bladder neck to the anterior fornix, followed by dissection from the pubocervical fascia at the bladder neck to the white line laterally and ischial spines superiorly. A protruding bulge, if present, is reduced with a purse string suture or midline plication. Next, a patient-tailored trapezoid-shaped graft is cut from a 10x7 cm sheet of four-layer Surgisis, partially rehydrated, and sutured to the boundaries of the anterior compartment to achieve a snug fit. The graft is first attached at the apex. With intact apical support, the graft is attached to the cervix or the vault scar. When apical support is deficient, it is sutured to the sacrospinous ligaments vaginally or to the uterosacral ligaments laparoscopically. The distal part of the graft is laterally attached to the white line at the level of the bladder neck and then transversally sutured to the bladder neck.

For the posterior compartment, repair starts with an inverted T incision beginning at the hymen and ending below the posterior fornix. The dissection is carried apically to the ischial spines, laterally to the pelvic side wall, and distally to the perineal body fascia. The apical arms of the graft are attached first. Then, the distal portion is trimmed and attached snugly to the perineal body fascia. Tacking sutures are placed to close the gap between the pelvic side wall and the lower half of the graft.

With combined anterior and posterior prolapse, a 20 x 7 cm four-layer Surgisis graft is cut and folded to create apical arms with anterior and posterior trapezoid extensions. The graft is attached superiorly with a non-absorbable suture; elsewhere a delayed absorbable suture is used. Redundant vaginal skin is trimmed and the wound closed with locking absorbable suture.

Cystoscopy is performed after anterior repair and a suprapubic catheter inserted under vision. Rectal examination is conducted after posterior repair to ensure absence of suture material in the rectum and exclude compression of the rectum.

Post-operatively, women are reviewed at six weeks, six months, annually up to three years, and then bi-annually. At each review they are questioned about prolapse symptoms and bowel, bladder, and sexual function. POPQ assessments [11] are made at each visit. Objective success is defined as POPQ Stage 0 or 1 in all compartments, and objective failure as Stage 2 or more in any compartment. Subjective success is defined as having no more than an asymptomatic bulge not protruding beyond the hymen and subjective failure as a recurrence of symptoms with no objective prolapse. Complications were classified and coded according to the International Urogynecological Association (IUGA) and International Continence

Society (ICS) joint terminology and classification of the complications related to the use of prostheses and grafts [12].

The study was approved by the Flinders Ethical Committee as an audit activity.

Results

Table 1 summarizes the pre-operative characteristics of our cohort. Of 65 women treated with Surgisis, 39 (60%) underwent an anterior and posterior repair. Sixteen (25%) had a posterior repair only and 10 (15%) an anterior repair only. Forty-four procedures (68%) involved attachment of Surgisis to either the sacrospinous or uterosacral ligaments. Other concomitant procedures included hysterectomy (37%), continence surgery (15%), hysteropexy (10%), and native tissue repair of another compartment (7.7%). Twenty-three of the total of 103 concomitant procedures were laparoscopically assisted and none involved open abdominal surgery.

The average duration of the combined procedures was 102 minutes with a median of 150 minutes (range: 50-240). Median estimated blood loss was 300 mL (range: 20 - 1,550 mL). Median duration of hospitalisation was 4 days (range: 2 - 43) and mean follow-up was 75 weeks.

Major surgical complications occurred in 4 women (6.2%). Three had an estimated blood loss >1,000 mL or required transfusion (IUGA / ICS classification [12]: 7A.T1). One woman suffered a small bowel injury not recognised at the time of laparoscopy (5C.T1.S5). Other complications included 13 (20.0%) vaginal/pelvic infections treated with oral antibiotics (1C.T2.S1/S2), 11 (16.9%) urinary tract infections, 12 women (18.5%) required a supra-pubic catheter for more than 7 days

(4B.T2), and 7 (10.8%) reported either persistent or de novo dyspareunia (1B.T4.S2). There were no cases of graft exposure, erosion, rejection, or seroma formation.

The objective success rate (POPQ Stage 0 or 1 in all compartments) was 66% (43 of 65). Of 22 objective failures, 16 had an asymptomatic bulge above the hymen giving a subjective success rate of 92%. Three women (4.6%) had repeat surgery; two are planning further surgery; and one remained symptomatic, but declined further surgery.

Table 2 shows the success rate per compartment repaired and Table 3 shows the sites affected by recurrence or subsequent prolapse. Of 10 women in the anterior only group, four developed further prolapse: one recurrence of cystocoele and three de novo rectocoeles. One cystocoele and one rectocoele are asymptomatic (Aa = -1, Ap = -1) and two women with rectocoele (Ap = 0) underwent fascial repair. Among 16 women in the posterior only group, four had a subsequent prolapse. Three, all remaining asymptomatic, developed a de novo cystocoele (Aa = -1, Ba = -1, Aa = +1). The affected site was not recorded for the other.

Fourteen of 39 women treated with both anterior and posterior Surgisis experienced further prolapse (Table 3). Nine involved the anterior compartment, two the vault and anterior wall, one the vault only, one the posterior compartment only, and in one the site was not documented. Three of the anterior compartment recurrences were symptomatic and underwent surgery with permanent polypropylene mesh.

Overall, the anterior recurrence rate was 12 of 49 (24.5%) and the same site re-operation rate (planned and performed) was 3 of 49 (6.1%). After anterior repair two women developed a rectocoele that required repair. The posterior recurrence rate was one in 55 (1.8%) with no re-operations required.

Table 1. Patient characteristics and pre-operative assessments.

Characteristic	Number	Percent
Age in years (median, range)	66 (40 – 84)	
Weight in kg (median, range)	75 (48 – 110)	
Parity (median, range)	2 (0 – 4)	
Previous treatments		
Oestrogens	46	70.8
Physiotherapy	49	75.4
Pessary	38	58.5
Hysterectomy	28	43.1
Prolapse surgery	27	41.5
Prolapse stage (POPQ) [11]		
2	36	55.4
3	28	43.1
4	1	1.5
Presenting symptoms		
Vaginal lump	53	81.5
Bladder symptoms	37	56.9
Urgency	28	43.1
Stress	20	30.8
Hesitancy / retention	12	18.5
Recurrent infection	2	3.1
Bowel symptoms	26	40.0
Evacuation difficulty	22	33.8
Faecal / flatal incontinence	4	6.2
Pain	7	10.8
Dyspareunia	3	4.6
Back pain	2	3.1
Dragging discomfort	1	1.5

Table 2. Success and failure rates according to the compartment repaired.

Compartment repaired	No. of patients	Objective cure *	Subjective cure *	Failure
Anterior	10 (15.4%)	6	8	2
Posterior	16 (24.6%)	12	15	1
Both	39 (60.0%)	25	36	3
Total	65 (100%)	43	59	6

* Objective cure is defined as POPQ stage <2 at the last follow-up. Subjective cure refers to women with no symptoms, no bulge beyond the hymen, and happy with the result.

Table 3. Site of recurrence or subsequent prolapse according to the compartment repaired.

Site of subsequent prolapse	Compartment repaired		
	Anterior (n = 10)	Posterior (n = 16)	Anterior & Posterior (n = 39)
Apical	–	–	3
Anterior	1	3	11
Posterior	3	–	1
Not specified	–	1	1
Total	4	4	14 *

* Two women had a subsequent prolapse in two compartments (vault and anterior wall).

Table 4 displays the timing and site of subsequent prolapse regardless of the site repaired. There was a failure rate of 29% (16% objective and 13% subjective) in women followed up to a year. This rate did not change significantly for those followed up to five years, but absolute numbers are small. Symptomatic recurrences did not appear to increase over time.

Table 4. Success and failure rates according to the duration of follow-up.

Duration of follow-up	No. of patients	Objective cure *	Subjective cure *	Failure
Up to 1 year	65	43	59	6
Up to 3years	33	20	31	2
Up to 5 years	10	7	10	0
More than 5 years	3	2	3	0

* Objective cure is defined as POPQ stage <2 at the last follow-up. Subjective cure refers to women with no symptoms, no bulge beyond the hymen, and happy with the result.

Discussion

The quest for the ultimate prolapse repair continues unabated despite the availability of various prosthetic and graft materials. Although it is generally accepted that they result in lower short-term recurrence rates, especially in the anterior compartment, there are also substantial drawbacks. These include significant prosthesis- and graft-related complications, difficulty treating subsequent failures, and no demonstrated benefit on quality of life and sexual function [5,13-15]. The ideal graft material would allow correction of vaginal anatomy whilst maintaining pelvic organ function. It would be bio-compatible, inert, sterile, resistant to physical modification,

mechanical stress and shrinkage, readily available, inexpensive, with minimal risks of infection and rejection [16].

Biological grafts from other species (xenografts) have been used to repair hernias and pelvic organ prolapse for many years [17]. They are thought to reduce complications of erosion, fistula formation and infection seen with permanent prosthetic material [6]. Several xenografts are currently used in vaginal reconstruction [17]. They differ in species of origin (bovine or porcine), site of harvest (pericardium, dermis, intestinal submucosa), sterilisation process, and cross-linking during manufacture.

Surgisis is an acellular, three-dimensional lattice of collagen and extra-cellular matrix, not cross-linked, derived from the submucosa of porcine small intestine. Being acellular, Surgisis minimises risks of viral or prion transmission, inflammatory responses, rejection, and exposure [7,16]. The absence of chemical cross-linking facilitates colonisation by host cells and avoids encapsulation and poor fixation at the graft-host interface, which could weaken the repair [6]. The matrix encourages host angiogenesis, connective tissue and epithelial differentiation and ingrowth, eventually replacing the graft with constructive connective tissue remodelling instead of scar tissue [18]. Graft resorption is believed to reduce long-term complications, such as graft exposure and dyspareunia. Concern remains, however, about the durability of the repair after re-modelling [6].

Apart from congress abstracts, there are very few studies on the use of Surgisis in pelvic floor repair. These include one randomised controlled trial of women undergoing anterior compartment repair [8] and three retrospective comparative studies [7,9,10]. The randomised trial with 56 patients compared Surgisis with traditional anterior colporrhaphy [8]. The anatomical cure (POPQ

Stage 0 or 1) at 12 months was 86.2% with Surgisis and 59.3% with conventional colporrhaphy [8]. Improvement in quality of life was similar in both groups. More intra-operative complications, mainly "excessive" blood loss without transfusion, occurred in the Surgisis group. There were no graft infections or exposures. In women treated for recurrent cystocoele, anterior colporrhaphy had a much higher failure rate than Surgisis (57.1% versus 14.3%). This supports the contention that women with recurrent prolapse are likely to have intrinsically weak support tissue or poor healing, benefiting most from augmented repair.

Chalaha *et al.*[7] reported on 28 women undergoing either colporrhaphy or Surgisis augmentation for anterior prolapse and found an improvement in objective measurements and quality of life at six months, but no difference at two years. However, lack of randomisation and small numbers limit interpretation of these data. A comparative study by Mouritsen *et al.* [9], with a median follow-up of three years, found better results with Surgisis than with anterior or posterior colporrhaphy, but the difference was not statistically significant. Reid and Luo [10] compared 108 bridging graft vaginal paravaginal repairs (89 using Surgisis) with 59 native tissue cystocoele repairs [10]. With bridging grafts, cystocoele persistence was reduced from 10.2% to 4.6% and late recurrences from 22.6% to 4.9% [10].

A randomised trial reported by Paraiso *et al*. [19] is often considered relevant to the use of porcine implants in rectocoele repair [14]. It compared three different techniques, one of which included a porcine-derived graft (Fortagen). There was a significant improvement in quality of life and sexual function in all groups, but the Fortagen group had the highest anatomical failure rate. However, Fortagen is cross-linked and more prone to encapsulation and poor fixation at the graft-host interface than Surgisis.

The current study presents 65 women followed for a variable time up to six years. Compared with other studies mentioned, our failure rate is slightly higher for the anterior compartment, but lower for the posterior compartment. Our results, relating predominantly to women with previous surgery or considered at increased risk of recurrence, support the use of Surgisis. Most subjective failures also occurred in the unrepaired compartment. The anterior only group had four 'failures' two of which were symptomatic rectocoeles that underwent repair. Of the four 'failures' in the posterior only group, three were anterior and they remain asymptomatic. The development of de novo prolapse after repair could be due to a delayed manifestation of generally weak support tissue, under-treatment (prolapse in one compartment missed or masked by prolapse in another) or alteration in the vaginal axis, predisposing to later prolapse. More often than not, pelvic floor dysfunction is not confined to a single support structure [20]. Subclinical poor support in a particular compartment may thus become more manifest after correction of visible prolapse in another [20].

Thus far, Surgisis shows most promise in the treatment of recurrent rectocoele. At Flinders urogynaecology, fascial repair remains the primary approach for posterior prolapse. Surgisis is used for recurrences and permanent mesh is used when both these procedures failed. For anterior prolapse, the approach is dictated by the integrity of the levator muscle [21], vaginal rugation, and vaginal saculation. With clinically intact levators and no saculation, anterior colporrhaphy is the primary approach. With avulsed levators, intact rugae, and no saculation, laparoscopic paravaginal repair is preferred. The remaining cases of cystocoele are at high risk of recurrence with native tissue repair and require graft or prosthetic augmentation. In

these circumstances, Surgisis is used for the primary repair and permanent mesh for recurrences.

In general, the frequency of recurrence after prolapse repair increases with time [22]. There were no indications to that effect in our study. This suggests that Surgisis, when effective, achieves a durable result, perhaps because the new connective tissue is stronger than the original or because the graft offers critical support while the new connective tissue gains in strength. However, 75% of the operations were performed between 2007 and 2009, resulting in only 10 with a follow-up of more than three years. This emphasises the well-recognized need for long-term follow-up after prolapse surgery, difficult to achieve as it may be, particularly when people remain asymptomatic.

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CHAPTER 10

General Discussion

Chapter 1 introduces the subject with a general history of the development of laparoscopic pelvic floor repair internationally and, more specifically, at Flinders Medical Centre. Emphasis is given to the many innovative developments that led from laparoscopy as a diagnostic procedure to an operative procedure and further on to its application to correct anatomic defects in each pelvic compartment. This historical review provides an opportunity to reflect on how current methods and techniques may still be improved to deal with an issue that is likely to become even more prevalent as our population continues to age.

Chapter 2 results from a survey of how Australian and New Zealand gynaecologists manage prolapse. The 2007 survey is compared with an identical survey conducted in the United Kingdom a year earlier. The response rate was low, with only 196 responses received, but valuable insight was obtained about the management of four clinical scenarios. There was a wide variation in the management of prolapse for each pelvic compartment. Laparoscopic procedures were used by a minority of Australian and New Zealand gynaecologists to treat primary and recurrent prolapse in all compartments and laparoscopic hysteropexy was the procedure of choice when uterine preservation was warranted to maintain reproductive function. Overall, Australian and New Zealand gynaecologists used fewer traditional transvaginal procedures in the anterior and posterior compartments and more vaginal meshes and grafts in all compartments than their British counterparts. Synthetic suburethral slings have replaced open and laparoscopic Burch colposuspension as the gold standard procedure for urodynamic stress incontinence.

Chapter 3 presents our first two years of experience with laparoscopic prolapse

repair in 73 women using native tissue and permanent braided material. The study reports on outcomes of repairs in the anterior, apical and posterior pelvic compartments. Some women had a concurrent colporrhaphy. At a mean follow-up of 8 months (range: 0 to 26 months), the overall objective success rate (POPQ stage 0 or 1) was 90 percent. The major complication rate was 4.1 percent. Subjective outcomes were assessed without a standardised quality of life questionnaire. However, most women reported an improvement in their presenting complaint(s). Ninety percent of women were contacted and 85 percent reported they would recommend the operation to a friend. The results, therefore, showed short term efficacy, both subjective and objective, for laparovaginal pelvic floor repair and compared favourably with other published series of laparoscopic, open abdominal and vaginal pelvic floor repair.

Chapter 4 presents data on 212 women who underwent laparoscopic treatment of anterior compartment prolapse with paravaginal repair, which was combined with uterosacral suspension for associated apical defects (n = 47) and supralevator repair for posterior defects (n = 42). Multi-compartment defects were treated in sequence from posterior to apical, then anterior. Anterior recurrences were treated by anterior colporrhaphy reinforced by a vaginal skin graft (n = 18). During the study period (1999 – 2004), we used laparoscopic paravaginal repair as the blanket procedure for all cystocoeles, replacing anterior colporrhaphy as the procedure of choice. In addition, all anterior recurrences represented residual or recurrent defects in the central portion of the pubocervical fascia, and were treated by graft-reinforced colporrhaphy. This two-stage approach to the complete treatment of anterior compartment defects gave an anatomic cure rate (POPQ stage 0 or 1) of 80 percent

with an average follow-up of 14.2 months. The approach is unique in that both stages involved a native tissue repair.

Most recurrences in the anterior compartment occurred in women with both lateral and central defects of the anterior compartment. The study found that one third of the anterior recurrences were progressive and became symptomatic within 4 years of the primary operation, but 64 percent did not require a follow-up procedure.

A subsequent review of those women who presented with surgical failure within 6 weeks of their surgery (unpublished data) suggested that a cystocoele resembling Santa's sac is inadequately addressed by paravaginal and apical repair and requires a graft-reinforced repair from arcus to arcus.

Chapter 5 reports on the long-term outcome of laparoscopic paravaginal repair and associated procedures with 106 of 223 women (46 %) followed for more than 5 years. Twenty four percent of women had an anterior recurrence beyond the hymen and 30% eventually had a repeat anterior compartment operation (median time to re-operation: 2.6 years). This study shows that, using this form of native tissue repair, cystocoeles are difficult to repair successfully. Nevertheless, most women with cystocoele were successfully managed without using permanent mesh. Considering the complications not infrequently associated with the use of permanent mesh, this may be the greatest advantage of the laparoscopic approach and should encourage more gynaecologists and patients to consider it.

In **Chapter 6** the focus is the apical (central) compartment and the therapeutic challenge of dealing with enterocoele. The technique uses a combination of

supralevator repair as the foundation stone, enterocoele sac excision to normalise vaginal length and to reapproximate the fascial remnants of the anterior and posterior compartments, uterosacral suspension of the neovault, and application of vaginal graft in selected cases. Concomitant procedures were performed when necessary to treat prolapse in adjacent compartments. The procedural morbidity and objective success (POPQ stage 0 or 1) are assessed in 45 women. The operating time, blood loss, postoperative stay and major complications are similar to the initial series. Eleven percent developed POPQ 2 or greater cystocoele and the overall objective cure for enterocoele at 3 years was 93 percent.

In **Chapter 7**, a decade of experience with laparoscopic supralevator repair is presented. Data were available for 144 women treated in this manner. The repair was found to have the following advantages: the laparoscopic approach gives better access to a high rectocoele than the vaginal approach; it uses native tissue and permanent braided suture material and does not rely on permanent mesh; the vagina is left intact unless an enterocoele sac requires excision; and the postoperative appearance of the vagina is normal in comparison to that seen after vaginal repair. In Australian clinical practice, the procedure has been superseded by mesh sacral colpopexy. This may be due to better Medicare remuneration, despite the mesh procedure being more technically demanding and the supralevator repair giving similar anatomic results without the use of permanent mesh and its potentially serious complications.

Chapter 8 addresses the important question of whether uterine preservation versus removal of the uterus affects the durability of uterosacral suspension for the

treatment of apical defects. Hysteropexy has been proposed as a fertility-sparing procedure in young women who desire pregnancy in the future and in whom conservative measures for prolapse have failed. This chapter reports on the outcome of two cohorts, one consisting of 104 hysteropexies and the other of 160 hysterectomies with concurrent colpopexy performed by several trainee and consultant gynaecologists from 1999 to 2010. Apical suspension procedures were classified as prophylactic for POPQ stage 1 descent of the apex and as therapeutic when used for POPQ stage 2 to 4 apical prolapse.

With a median follow-up of 2.5 years, objective success rates (POPQ stage <2 in all compartments) for uterosacral hysteropexy were 53 percent for prophylactic and 41 percent for therapeutic procedures. For hysterectomy with uterosacral colpopexy they were 66 percent for prophylactic and 59 percent for therapeutic procedures. Re-operation rates overall were 28 percent for hysteropexy and 21 percent for hysterectomy with colpopexy. Failures at the apex specifically were 27 percent for hysteropexy and 11 percent for hysterectomy with colpopexy ($p < 0.02$).

Laparoscopic hysterectomy with uterosacral colpopexy, whether performed prophylactically or therapeutically, produced better objective success rates than laparoscopic uterosacral hysteropexy. Uterine preservation may be justified when fertility preservation is paramount and in cases of vaginal prolapse with POPQ stage 1 uterovaginal prolapse when repairing adjacent compartments. Concurrent shortening of the round ligaments (ventrosuspension) may then reduce the future risk of cervical elongation.

Chapter 9 reports on the results of Surgisis-augmented pelvic floor repair in 65 women between 2003 and 2009. Initially, Surgisis was adopted in cases of recurrent

prolapse where graft usage was felt to be imperative for durability, and it avoided the controversy of using permanent mesh until more clinical data on the latter became available. The early Surgisis cases involved the transvaginal treatment of cystocoele recurrence after laparoscopic repair and rectocoele recurrence after posterior colporrhaphy. Subsequently, a laparovaginal approach was adopted which combined vaginal introduction and distal fixation of the graft together with laparoscopic paravaginal and apical suspension. Ultimately, a completely transvaginal approach was found to be the most time-efficient, but it required refinement in the skill of fixing the graft to the sacrospinous ligaments and white lines. The results of Surgisis repair are encouraging as all women were considered to be at high risk of prolapse recurrence and the results from treating recurrent rectocoele were the best. The final part of the discussion outlines the "procedural sieve" which is applied in the assessment of prolapse to discern the optimum procedure for each patient.

Conclusion

In essence these studies have shown that, in pelvic floor repair, there is a significant advantage from having the ability to approach prolapse from above as well as from below. The prime advantage of laparoscopic pelvic floor repair using sutures is that permanent mesh, which occasionally has severe complications, can often be avoided. A drawback is that laparoscopic procedures can be time consuming particularly when, as is not infrequently the case, extensive adhesions are present. The main hurdle, though, remains the acquisition of the necessary laparoscopic suturing skills. Fortunately, in Australia and elsewhere, there are now several practical workshops where such skills can be learnt. Laparoscopic pelvic floor repair undoubtedly complements the vaginal approach and, thereby, usefully expands the possibilities of

corrective pelvic floor surgery. Possessing a combination of vaginal and laparoscopic skills allows the pelvic floor surgeon to offer a complete range of procedures optimally adapted to an individual patient's needs.

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