Pelvic Floor Digest

*This section presents a small sample of the Pelvic Floor Digest, an online publication (**www.pelvicfloordigest.org**) that reproduces titles and abstracts from over 200 journals. The goal is to increase interest in all the compartments of the pelvic floor and to develop an interdisciplinary culture in the reader.*

FORUM

Editor's note: importance of revealing any author conflicts of interest. *Lin K. Am Fam Physician 2007;75:472.*

Introduction to nanotechnology: potential applications in physical medicine and rehabilitation. *Gordon AT, Lutz GE, Boninger ML, Cooper RA. Am J Phys Med Rehabil 2007;86:225-41.* Nanotechnology may transform the diagnosis and treatment of disease in the 21st century through the study, design, manipulation, manufacture, and control of materials or devices by physical or chemical means at resolutions in the order of one billionth of a meter. The review discusses potential developments in tissue engineering, drug delivery, imaging, diagnostics, surface texturing, and biointerfaces that could impact the practice of medicine.

1 – THE PELVIC FLOOR

Marketed vaginal mesh kits: rampant experimentation or improved quality of care? : Thoughts following the 2006 AUGS meeting by AUGS president Ingrid Nygaard, M.D. *Nygaard I. Int Urogynecol J Pelvic Floor Dysfunct 2007;18:483-4.*

Effects of aging on lower urinary tract and pelvic floor function in nulliparous women. *Trowbridge ER, Wei JT, Fenner DE, Ashton-Miller JA, Delancey JO. Obstet Gynecol. 2007;109:715-720.* To evaluate the effects of aging, independent of parity, on pelvic organ and urethral support, urethral function, and levator function, 82 nulliparous women (21-70 years) underwent pelvic examination using pelvic organ prolapse quantification, urethral angles by cotton-tipped swab, and multichannel urodynamics and uroflow. Vaginal closure force was quantified using an instrumented vaginal speculum. Increasing age was associated with decreasing maximal urethral closure pressure with a 15-cm-H2O decrease in pressure per decade. Pelvic organ support as measured by POPQ and levator function did not differ by age group.

2 – FUNCTIONAL ANATOMY

Histological features of the rectovaginal septum in elderly women and a proposal for posterior vaginal defect repair. *Nagata I, Murakami G, Suzuki D et al. Int Urogynecol J Pelvic Floor Dysfunct 2007 Mar 1; Epub.* To develop a novel surgical procedure for posterior vaginal defect repair, the rectum-vagina interface tissues obtained from 20 elderly cadavers were examined histologically. The rectovaginal septum was defined as an elastic fiber-rich plate along the vaginal wall, lining the posterior surface of the vein-rich zone and extending between the bilateral paracolpums. The septum, often thin and interrupted, was more evident in the lower half of the interface. In the upper vagina augmentation using some implant is then considered to be necessary for the enterocele and high rectocele.

Regulation of MMP-1 by sex steroid hormones in fibroblasts derived from the female pelvic floor. *Zong W, Zyczynski HM, Meyn LA et al. Am J Obstet Gynecol 2007;196:349.e1-11.* To investigate the effect of sex steroid hormones on the overall expression profile of cellular matrix metalloproteinase-1 (MMP-1) in fibroblasts derived from arcus tendineus fasciae pelvis, a premenopausal woman and a postmenopausal woman undergoing a prolapse repair were treated with physiologic concentrations of 17-beta-estradiol (E2), progesterone, E2 plus progesterone, and E2 plus ICI 182,780. Cellular expressions of the latent, active, and fragment forms of MMP-1 were analyzed and the latent and fragment forms were increased by E2, progesterone, and E2 plus progesterone, while the active form was not changed by either E2 or progesterone alone but was decreased significantly when both hormones were added together. ICI 182,780 inhibited the stimulatory effect of E2. Both E2 and progesterone are necessary to maintain the integrity of female pelvic floor.

3 – DIAGNOSTICS

Impact of lower urinary tract symptoms on quality of life using Functional Assessment Cancer Therapy scale. *Batista-Miranda JE, Molinuevo B, Pardo Y.Urology 2007;69:285-8.* In male patients LUTS have considerable impact on the general well-being. Combined with age, they can explain up to 30% of the variance in QOL. Nocturia and incomplete emptying are the most troublesome symptoms.

Validating a clinical measure of levator hiatus size. *Boyles SH, Edwards SR, Gregory WT et al. Am J Obstet Gynecol 2007;196:174.e1-4.* The interrater reliability of levator hiatus (LH) size was evaluated and correlated to other measures of muscle function. During maximal contraction of the levator ani, the muscle was assessed independently by 2 examiners by using Brink's scale. The LH was measured in the transverse and sagittal dimensions by digital palpation. The mean LH transverse was 4.5 cm and the mean LH sagittal was 3 cm with a good interrater reliability.

Quantification of major morphological abnormalities of the levator ani. *Dietz HP. Ultrasound Obstet Gynecol 2007;29:329-34.* A quantification of morphological abnormalities of the levator ani found in a significant minority of women presenting with symptoms of pelvic floor dysfunction was attempted using tomographic 3D translabial pelvic floor ultrasound in 262 consecutive women referred for complaints of lower urinary tract dysfunction and prolapse. Main outcome measures were craniocaudal and ventrodorsal extent of defects of the pubovisceral muscle. Avulsion injuries were diagnosed in 19% of the women, 21.3% of the vaginally parous. Defects were found unilaterally and bilaterally. Hiatal area on Valsalva was correlated weakly with defect score and total defect width. Defect score and maximum width were significantly higher in women with prolapse.

Rectal cooling test in the differentiation between constipation due to rectal inertia and anismus. *Shafik A, Shafik I, El Sibai O, Shafik AA. Tech Coloproctol 2007;11:39-43.* The differentiation between constipation due to rectal inertia and that due to outlet obstruction from non-relaxing puborectalis muscle is not easily achieved with one diagnostic test. Rectal infusion with iced saline increased rectal tone in healthy controls and constipated patients with anismus while it had no effect in the remaining patients. Lack of increase of rectal tone may be secondary to rectal inertia. Therefore the test can effectively differentiate between the two forms of constipation.

High-resolution manometry in the evaluation of anorectal disorders: a simultaneous comparison with water-perfused manometry. *Jones MP, Post J, Crowell MD. Am J Gastroenterol 2007;102:850-5.* High-resolution manometry combined with novel interpretive software allows for the interpolation of manometric recordings into highly detailed topographical plots of intraluminal pressure events relative to time and location, providing, in patients with constipation, incontinence, and fecal soilage greater resolution of the intraluminal pressure environment of the anorectum compared to water-perfused manometry.

Intermittent bowel obstruction due to a retained wireless capsule endoscope in a patient with a small bowel carcinoid tumour. *Strosberg JR, Shibata D, Kvols LK. Can J Gastroenterol 2007;21:113-5.* Two years after undergoing a wireless capsule endoscopy procedure, radiological examinations revealed a retained capsule endoscope causing partial small bowel obstruction. The capsule was retrieved through laparotomy.

Nurses working in GI and endoscopic practice: a review. *Verschuur EM, Kuipers EJ, Siersema PD. Gastrointest Endosc 2007;65:469-479.* Nurses increasingly perform tasks and procedures that were previously performed by physicians. The findings of this review support the involvement of nurses in diagnostic endoscopy and follow-up of patients with chronic GI disorders. Further randomized trials, however, are needed to demonstrate whether this involvement compares at least as favorably with gastroenterologists in terms of medical outcomes, patient satisfaction, and costs.

4 – PROLAPSES

Pelvic organ prolapse. *Jelovsek JE, Maher C, Barber MD. Lancet 2007;369:1027-38.* A complete review on pelvic organ prolapse. Many women with pelvic organ prolapse are asymptomatic and do not need treatment. When prolapse is symptomatic, options include observation, pessary use, and surgery. Radiographic assessment is usually unnecessary. Surgical strategies for prolapse can be categorised broadly by reconstructive and obliterative techniques. No effective prevention strategy for prolapse has been identified.

Natural history of pelvic organ prolapse in postmenopausal women. *Bradley CS, Zimmerman MB, Qi Y, Nygaard IE. Obstet Gynecol 2007;109:848-854.* To describe the natural history of pelvic organ prolapse and risk factors for changes in vaginal descent in older women, a 4-year prospective observational study included 259 postmenopausal women with the uterus. Prolapse progresses and regresses in older women, although rates of vaginal descent progression are slightly greater than regression overall. Obesity and grand multiparity are risk factors for progression.

Sonomorphological evaluation of polypropylene mesh implants after vaginal mesh repair in women with cystocele or rectocele. *Tunn R, Picot A, Marschke J, Gauruder-Burmester A. Ultrasound Obstet Gynecol 2007;29:449-52.* To investigate whether the sonographically measured size of the mesh implant, after 6 weeks correlates with the original size, and whether the mesh ensures complete support of the anterior (transobturator implant) or posterior (transischioanal implant) compartment, 40 postmenopausal women with cystocele or rectocele were evaluated with introital ultrasound. The mesh supported 43.4% of the length of the anterior and 53.7% of the posterior vaginal wall. There is a considerable discrepancy between the implanted mesh size and the length measured 6 weeks later.

New technique for the repair of anterior pelvic floor compartment defects using a synthetic implant with biological coverage: approach, fixation and transobturator anchoring. *Moreno Sierra J, Prieto Nogal SB, Galante Romo MI et al. Arch Esp Urol 2007;60:45-50.* Transobturator systems for anterior vaginal wall prolapse repair may be considered an approach and also a mesh fixation system, in opposition to free mesh cystocele repair where they work by the creation of fibrotic tissue after biological or synthetic mesh implant. The design and technology of the Avaulta anterior system is described, which exemplifies the current trend in pelvic floor surgery.

Uncontrollable intra-abdominal bleeding necessitating low anterior resection of the rectum after stapled hemorrhoidopexy: report of a case. *Blouhos K, Vasiliadis K, Tsalis K et al. Surg Today 2007;37:254-7.* One of the most serious complications of stapled hemorrhoidopexy is severe bleeding. A case of extensive hemoperitoneum without evidence of typical rectal bleeding is reported in a patient with third-degree hemorrhoids soon complaining severe abdominal pain and signs of peritonitis requiring an emergency exploratory laparotomy, which revealed extensive hemoperitoneum and a devitalized edematous rectum with a tense hematoma, 1 cm above the staple line. A low anterior resection was performed.

Stapled hemorrhoidopexy height as outcome indicator. *Williams R, Kondylis L, Geisler D, Kondylis P. Am J Surg 2007;193:336-9.* Postoperative expectations after stapled hemorrhoidopexy are still being clarified. To evaluate how outcome is affected by staple line height above the dentate line and specimen histology, 105 patients were analyzed, concluding that staple line height and histology can impact postoperative outcomes: the height should be >20 mm yet < or =40 mm above the dentate, avoiding squamous epithelium.

Delayed presentation of life-threatening perineal sepsis following stapled haemorrhoidectomy: a case report. *McCloud JM, Doucas H, Scott AD, Jameson JS. Ann R Coll Surg Engl 2007;89:301-2.* There have been several cases of Fournier's gangrene following stapled haemorrhoidopexy. A case in which this complication appeared 39 days after the operation is described. The patient recovered after wide tissue excision and fashioning of a colostomy.

5 – RETENTIONS

Use of nomogram to predict acute urinary retention. *Tang VC, Bott SR. Ann R Coll Surg Engl 2007;89:192.*

Tension-free vaginal tape: poor intraoperative cough test as a predictor of postoperative urinary retention. *Takacs P, Medina CA. Int Urogynecol J Pelvic Floor Dysfunct 2007 Mar 30; Epub.*

A randomized, multicenter, placebo-controlled trial of polyethylene glycol laxative for chronic treatment of chronic constipation. *Dipalma JA, Cleveland MV, McGowan J, Herrera JL. Am J Gastroenterol 2007 Mar 31; Epub.* Polyethylene glycol is currently approved for the short-term treatment of occasional constipation. This study was designed to compare the safety and efficacy of this laxative versus placebo over a 6-month treatment period in patients with chronic constipation: It proved to be safe and effective.

A washing toilet seat with a CCD camera monitor to stimulate bowel movement in patients with spinal cord injury. *Uchikawa K, Takahashi H, Deguchi G, Liu M. Am J Phys Med Rehabil 2007;86:200-4.* The effectiveness of a modified washing toilet seat equipped with a CCD camera monitor and an electronic bidet to facilitate precise hitting of the anal area with water streams to stimulate bowel movement in patients with traumatic spinal cord injury (SCI), was studied in 20 subjects at least 5 mos post acute injury. Bowel movement was successfully induced in 75% of the patients. Success was not related significantly to injury level, ASIA impairment scale, or ability to voluntarily squeeze. Compared with their usual manner of bowel management, for which they spent more than 30 mins, time needed for successful bowel movement was shortened without any complication.

Patients with functional constipation do not have increased prevalence of colorectal cancer precursors. *Chan AO, Hui WM, Leung G et al. Gut 2007;56:451-2.*

6 – INCONTINENCES

Postpartum depression, urge urinary incontinence, and overactive bladder syndrome: is there an association? *Hullfish KL, Fenner DE, Sorser SA et al. Int Urogynecol J Pelvic Floor Dysfunct 2007 Feb 17; Epub.* In this cross-sectional study an association between postpartum depression and symptoms of urge incontinence was found. Type of delivery, vaginal vs cesarean section, did not significantly impact the urge scores. Because birth is a predictable event, further studies evaluating the causal relationships and physiologic changes linking depression and incontinence can be studied using this model.

Experimental animal model for training transobturator and retropubic sling techniques. *Riccetto CL, Palma PC, Thiel M et al. Urol Int 2007;78:130-4.* Suburethral transobturator slings have become the treatment of choice for stress urinary incontinence, but the lack of experimental models for surgical training is a problem for beginners. An animal model (11-month-old Santa Ines sheep) for sling training is presented. As far as anatomical similarities of vaginal structures, cystoscopy and transvaginal sling 97% of 32 surgeons reported similarities or a strong correlation.

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Significance of tension in tension-free mid-urethral sling procedures: a preliminary study. *Paick JS, Oh JG, Shin JW et al. Int Urogynecol J Pelvic Floor Dysfunct 2007;18:153-8.* The results of the release and tape-shortening techniques in polypropylene pubovaginal mid-urethral slings are reported, tension playing a substantial role in restoring continence or experiencing urinary retention or other voiding difficulties.

13 years of experience with artificial urinary sphincter implantation at Baylor College of Medicine. *Lai HH, Hsu EI, Teh BS et al. J Urol 2007;177:1021-5. Between 1992 and 2005,* 270 patients underwent artificial urinary sphincter implantation (single surgeon). Of the 218 patients followed-up 176 underwent underwent prostatectomy with or without pelvic radiation, 11 had neurogenic bladder and 31 underwent secondary artificial urinary sphincter implantation. Complication rates were infection in 5.5% of cases, erosion in 6.0%, urethral atrophy in 9.6%, mechanical failure in 6.0% and surgical removal or revision in 27.1%. At 5 years 75% of patients had avoided revision or removal.

Physical activity and urinary incontinence among healthy, older women. *Danforth KN, Shah AD, Townsend MK et al. Obstet Gynecol 2007;109:721-727.* Physical activity is associated with a significant reduction in urinary incontinence. Results appear somewhat stronger for stress than urge UI.

Complications of sling surgery among female medicare beneficiaries. *Anger JT, Litwin MS, Wang Q et al. Obstet Gynecol 2007;109:707-14.* Complication rates within 1 year after sling surgery among Medicare beneficiaries were found to be higher than those reported in the clinical literature. The high rates of postoperative urinary tract infections, prolapse, and outlet obstruction suggest the need for quality improvement measures in the management of women with incontinence and pelvic prolapse.

Anatomic comparison of two transobturator tape procedures. *Zahn CM, Siddique S, Hernandez S, Lockrow EG. Obstet Gynecol 2007;109:701-6.* To compare outside-in (Monarc) and inside-out (TVT-O) methods for transobturator tape placement regarding proximity of the tape to the obturator canal and ischiopubic ramus, 7 cadavers were dissected to the level of the obturator membrane measuring the distance from the closest aspect of the obturator canal and ischiopubic ramus to each tape. The outside-in technique results in the mesh being placed farther from the obturator canal and closer to the ischiopubic ramus, theoretically reducing the risk of neurovascular injury.

Comparison of cystographic findings of intrinsic sphincteric deficiency with urethral hypermobility causing urinary incontinence. *Park SW, Sung DJ, Choi EJ et al. Urol Int 2007;78:116-20.* Intrinsic sphincter deficiency should be considered in female patients with symptoms of urinary incontinence where there are changes in posterior urethrovesical angle <20 degrees on a lateral cystogram between a stress state and resting state in addition to the beaking sign of the vesical neck during a resting state.

Sacral nerve stimulation for neurogenic faecal incontinence. *Holzer B, Rosen HR, Novi G et al. Br J Surg 2007 Apr 4; Epub.* Thirtysix patients with faecal incontinence of neurological aetiology were included in a trial of SNS and 29 had a permanent implant. Evaluation consisted of a continence diary, anal manometry, saline retention testing and quality of life assessment. After a median follow-up of 35 (range 3-71) months, 28 patients showed a marked improvement or complete recovery of continence. Saline retention time increased from a median of 2 (0-5) to 7 (2-15) min. Maximum resting and squeeze anal canal pressures, and quality of life on all scales, increased at 12 and 24 months after operation.

Internal anal sphincter defect influences continence outcome following obstetric anal sphincter injury. *Mahony R, Behan M, Daly L et al. Am J Obstet Gynecol 2007;196:217.e1-5.* To define the correlation between the extent of anal sphincter injury as seen by endoanal ultrasound and symptoms of postpartum fecal incontinence, 500 women were studied at 3 months following primary repair of a first recognized obstetric anal sphincter injury during vaginal delivery. US evidence of internal anal sphincter injury is predictive of severe incontinence (score greater than 9/20).

National audit of continence care for older people: management of faecal incontinence. *Potter J, Peel P, Mian S et al. Age Ageing 2007 Mar 13; Epub.* Faecal incontinence in older people is associated with considerable morbidity but is amenable to successful management. Basic assessment and care for truly integrated continence services by the professionals directly looking after older persons however is often lacking and there is an urgent need to re-establish the fundamentals of continence care into the daily practice of medical and nursing staff.

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7 – PAIN

Chronic prostatitis/chronic pelvic pain syndrome: role of alpha blocker therapy. *Lee SW, Liong ML, Yuen KH et al. Urol Int 2007;78:97-105.* Encouraging results in uncontrolled and small clinical trials led to the development of reasonably powered, double-blinded, placebo-controlled, randomized clinical trials evaluating terazosin, doxazosin, tamsulosin, and alfuzosin for chronic prostatitis/chronic pelvic pain syndrome (CP/CPPS), the most common and difficult prostatitis syndrome. Treatment-naive and/or newly diagnosed patients appear more likely to respond than long-term, chronic refractory patients.

Assessment of vulvodynia symptoms in a sample of US women: a prevalence survey with a nested case control study. *Arnold LD, Bachmann GA, Rosen R, Rhoads GG. Am J Obstet Gynecol 2007;196:128.e1-128.e6.* Vulvodynia is a chronic pain syndrome of unknown origin with scant data on frequency. A phone survey contacted 2127 US households to identify 100 symptomatic women. Current vulvar pain of at least 6 months duration was reported by 3.8% of respondents, with a 9.9% lifetime prevalence. Forty-five percent of women with pain reported an adverse effect on their sexual life and 27% an adverse effect on their lifestyle.

Limbic associated pelvic pain: A hypothesis to explain the diagnostic relationships and features of patients with chronic pelvic pain. *Fenton BW. Med Hypotheses 2007 Feb 8; Epub.* Limbic associated pelvic pain is a proposed pathophysiology designed to explain features commonly encountered in patients with chronic pelvic pain, including the presence of multiple pain diagnoses (endometriosis, interstitial cystitis, irritable bowel syndrome, levator ani syndrome, pelvic floor tension myalgia, vestibulitis, vulvodynia). This may occur in patients with chronic pelvic pain out of proportion to any demonstrable pathology (hyperalgesia) and with more than one demonstrable pain generator (allodynia). Chronic stimulation of the limbic system (anterior cingulate cortex, hippocampus and amygdala) by pelvic pain afferents produces an efferent contraction of the pelvic muscles, thus perpetuating the cycle.

Fatigue in irritable bowel syndrome: characterization and putative role of leptin. *Piche T, Huet PM, Gelsi E et al. Eur J Gastroenterol Hepatol 2007;19:237-43.* Fatigue occurs in 62.7% of irritable bowel syndrome patients if asked for, and influences all domains of the Fatigue Impact Scale, mostly the physical and the psychosocial domains. Fatigue is associated with circulating leptin levels independent from age, sex and BMI. The metabolic sequence involved in the occurrence of fatigue is to be determined.

The cognitive behavioural model of irritable bowel syndrome: a prospective investigation of gastroenteritis patients. *Spence MJ, Moss-Morris R. Gut 2007 Feb 26; Epub.* To determine whether a combination of mood and personality factors together with illness beliefs and behaviours predict the onset of irritable bowel syndrome post gastroenteritis, 49 patients were studied, those with high stress and anxiety levels being more prone to develop IBS after a bout of gastroenteritis. Additional risk factors include a tendency to interpret illness in a pessimistic fashion and to respond to symptoms in an all- or-nothing manner.

Probiotics and irritable bowel syndrome: a rationale for their use and an assessment of the evidence to date. *Quigley EM, Flourie B. Neurogastroenterol Motil 2007;19:166-72.* Probiotics, defined as live organisms that, when ingested in adequate amounts, exert a health benefit on the host, have been used for almost a century in the management of a variety of medical disorders, usually on the basis of little evidence. Advances in our understanding of the gut flora and of its relationship to the host, have identified their important role in the post-infective variety of IBS.

Role for protease activity in visceral pain in irritable bowel syndrome. *Cenac N, Andrews CN, Holzhausen M et al. J Clin Invest 2007;117:636-647.* Proteases are released in IBS and can directly stimulate sensory neurons and generate hypersensitivity symptoms through the activation of protease-activated receptor-2.

The degree of breath methane production in IBS Correlates with the severity of constipation. *Chatterjee S, Park S, Low K et al. Am J Gastroenterol 2007;102:837-41.* Among IBS subjects, methane on lactulose breath test is associated subjectively and objectively with constipation predominance, and the degree of methane production is related to the degree of constipation.

Immune activation in patients with irritable bowel syndrome. *Liebregts T, Adam B, Bredack C et al. Gastroenterology 2007;132:913-20.* To test the hypothesis that IBS is characterized by an augmented cellular immune response with enhanced production of proinflammatory cytokines, and to explore whether symptoms and psychiatric comorbidity in IBS are linked to the release of proinflammatory cytokines, 55 patients (18 mixed-, 17 constipation-, 20 diarrhea-predominant) were studied, and patients with D-IBS display enhanced proinflammatory cytokine release, this being associated with anxiety.

Morphological analysis of human acupuncture points through immunohistochemistry. *Wick F, Wick N, Wick MC. Am J Phys Med Rehabil 2007;86:7-11.*

8 – FISTULAE

Treatment of refractory urethrovaginal fistula using rectus abdominis muscle flap in a six-year-old girl. *Atan A, Tuncel A, Aslan Y. Urology 2007;69:384.e11-3.* Urethrovaginal fistula usually occurs after urethrovaginal injury, resulting in urinary incontinence. The rectus abdominis muscle flap was used in a 6-year-old girl with refractory urethrovaginal fistula.

The Addis Ababa fistula hospital: an holistic approach to the management of patients with vesicovaginal fistulae. *Williams G. Surgeon 2007;5:54-7.* Ethiopia is amongst the world's poorest countries. It is estimated that approximately 30,000 women have an untreated, neglected, vesicovaginal fistula. The Fistula Hospital in Addis Ababa in Ethiopia, founded in 1975 and run entirely by charitable donations, is dedicated exclusively to the care of women with obstetric fistulae, and the treatment of other physical and social injuries they have sustained.

Perianal fistulas in Crohn's disease: MRI diagnosis and surgical planning : MRI in fistulazing perianal Crohn's disease. *Szurowska E, Wypych J, Izycka-Swieszewska E. Abdom Imaging 2007 Mar 3; Epub.*

Perianal mucinous adenocarcinoma arising from chronic anorectal fistulae: a review from a single institution. *Ong J, Jit-Fong L, Ming-Hian K et al. Tech Coloproctol 2007;11:34-8.* Mucinous adenocarcinoma arising from a chronic anorectal fistula is rare, with few reports in the literature. A high index of clinical suspicion is required to make the diagnosis of perianal tumours while assessing patients presenting with perianal inflammatory conditions. Abdominoperineal resection is the surgical treatment of choice and can provide good long-term results in patients with localized disease.

9 – BEHAVIOUR, PSYCHOLOGY, SEXOLOGY

Complications and Sexual Function After Vaginectomy for Anorectal Tumors. *Hendren SK, Swallow CJ, Smith A et al. Dis Colon Rectum 2007 Feb 15; Epub.* Among 54 patients who underwent vaginectomy during anorectal tumor resection 19 had flap reconstruction of the vagina and 35 had primary repair, 83% experienced surgical complications. Twenty-three patients completed a questionnaire: only 6 were able to have sexual intercourse. No living patients who had flap reconstruction were able to have sexual intercourse. Only 20 percent of patients remembered a preoperative discussion of possible sexual effects of surgery; however, overall quality of life was preserved.

Sildenafil citrate improves erectile function and urinary symptoms in men with erectile dysfunction and lower urinary tract symptoms associated with benign prostatic hyperplasia: a randomized, double-blind trial. *McVary KT, Monnig W, Camps JL Jr et al. J Urol 2007;177:1071-7.* Improved erectile dysfunction and lower urinary tract symptoms with sildenafil in men with the 2 conditions were associated with improved quality of life and treatment satisfaction. Daily dosing with sildenafil may improve lower urinary tract symptoms. However, the lack of effect on urinary flow rates may mean that a new basic pathophysiology paradigm is needed to explain the etiology of lower urinary tract symptoms.

The psychological burden of premature ejaculation. *Rowland DL, Patrick DL, Rothman M, Gagnon DD. J Urol 2007;177:1065-70.* Premature ejaculation (latency time of 2 minutes or less) has a significant psychological burden on men, their partners and the male/partner relationship.

Evaluation of sexual function in women with overactive bladder syndrome. *Sen I, Onaran M, Tan MO et al. Urol Int 2007;78:112-5.* Women with OAB were divided into wet and dry groups. Scores of all domains (desire, arousal, lubrication, orgasm, satisfaction, pain and total) were found to be lower than in the control group, only 'desire' was found to be significantly different.

Sexual function after tension-free vaginal tape procedure. *Marszalek M, Roehlich M, Racz U et al. Urol Int 2007;78:126-9.* Among 52 women after a TVT procedure 74.0% indicated that they became totally continent. One third of the sexually active women reported an improvement of their sexual life, 14.3% a worsening, and 52.4% no change. Deterioration of sexual function was significantly associated with de novo urge, dyspareunia and sensation of postvoid residual urine volume. In summary the influence of the TVT procedure on female sexual function is evident, but of low impact, and in general will not be of relevance.

GPs' perception of their role in the identification and management of family violence. *Miller D, Jaye C. Fam Pract 2007;24:95-101.* The GPs' estimation of family violence prevalence in their practices is low compared to community-based research. Many issues affect the GP in identifying and managing family violence and must be considered in developing guidelines and training, referral systems and support.

Erectile dysfunction correlates with left ventricular function and precedes cardiovascular events in cardiovascular high-risk patients. *Baumhakel M, Bohm M. Int J Clin Pract 2007;61:361-6.* Erectile dysfunction (ED) is related to cardiovascular risk factors by an impairment of endothelial function, therefore, this symptom is probably to precede cardiovascular disease and events, and cardiovascular evaluation is recommended in patients with ED providing the opportunity of optimised preventional treatment.

Phalloplasty and urethroplasty in children with penile agenesis: preliminary report. *De Castro R, Merlini E, Rigamonti W, Macedo A Jr. J Urol 2007;177:1112-6.* Patients affected by penile agenesis, are better raised according to their karyotype and hormonal production, and opposite gender should not be assigned. Definitive phalloplasty in adults may achieve good results. Nevertheless, this procedure is generally performed in postpubertal boys and it is not easily available everywhere.

An evolutionary interpretation of the significance of physical pain experienced by human females: Defloration and childbirth pains. *Maul A. Med Hypotheses 2007 Feb 16; Epub.* The phenomena surrounding the pains related to first coitus and delivery have been poorly investigatedn in human sexuality and reproductive behavior as regards their evolutionary aspects. In particular the function of the hymen and the significance of defloration are largely misunderstood. Childbirth and defloration pains are hypothesized to manifest an adaptation designed to increase inclusive fitness in human evolutionary history, the significance of pain as a message being essentially emotional. The intense sexual emotions that may precede and follow the pain, the breaking and bleeding of the hymen, may generate strong feelings in the newly formed couple, and the labor pain may create mutual solicitude among the protagonists (imidwifes, father, mother) beneficial to all of them, and more particularly to the newborn. These behavioral implications may increase the stability of the connection between partners and indirectly to the survival, especially in former times, of the child.

Woman with incontinence and a history of childhood sexual abuse. *Wallace JD. Urol Nurs 2007;27:38-9.*

10 – MISCELLANEOUS

Immediate postoperative complications of combined penetrating rectal and bladder injuries. *Crispen PL, Kansas BT, Pieri PG et al. J Trauma 2007;62:325-9.* Combined penetrating trauma involving the rectum and bladder has been associated with increased postoperative complications: colovesical fistula, urinoma, abscess formation. Isolated rectal (29), isolated bladder (16), or combined injury (24) were compared. Presacral drainage was utilized in all patients with extraperitoneal injuries. Fecal diversion was performed in all patients, except two with intraperitoneal rectal injuries. Omental flap interposition between rectal and bladder injuries was utilized in one patient. No significant difference was noted in immediate postoperative complications between groups, however, all cases of colovesical fistula (2) and urinoma (2) formation were noted in those patients with rectal and posterior bladder injuries. Consequently, these patients may benefit from omental flap interposition between injuries.

Rokitansky syndrome: clinical experience and results of sigmoid vaginoplasty in 23 young girls. *Khen-Dunlop N, Lortat-Jacob S, Thibaud E et al. J Urol 2007;177:1107-11.* Sigmoid vaginoplasty provides a functional self-lubricating neovagina and is a valuable procedure recommended during adolescence because the local conditions are excellent and it allows adaptation of the anatomy to physical development.

Urinary tract injuries during obstetrics and gynaecological surgical procedures at the Aga Khan University Hospital Karachi, Pakistan: a 20-year review. *Nawaz FH, Khan ZE, Rizvi J. Urol Int 2007;78:106-11.*

The posterior urethra in anorectal malformations. *Mickelson JJ, Macneily AE, Blair GK. J Pediatr Surg 2007;42:585-7.*

Lateral internal sphincterotomy is superior to topical nitroglycerin for healing chronic anal fissure and does not compromise long-term fecal continence: six-year follow-up of a multicenter, randomized, controlled trial. *Brown CJ, Dubreuil D, Santoro L, Liu M, O'connor BI, McLeod RS. Dis Colon Rectum 2007 Feb 13;. Epub.*

Relaxation of the isolated human internal anal sphincter by sildenafil. *Ballester C, Sarria B, Garcia-Granero E et al. Br J Surg 2007 Mar 5; Epub.* The relaxant effects of sildenafil, a selective phosphodiesterase 5 (PDE5) inhibitor, supports its potential use in the treatment of chronic anal fissure.

Inflammatory bowel disease: past, present, and future. *Sands BE. J Gastroenterol 2007;42:16-25.* Crohn's disease and ulcerative colitis (IBD), are associated with the rise of modern, westernized industrial society. Although the causes of these diseases remain incompletely understood, the prevailing model is that the intestinal flora drives an unmitigated intestinal immune response and inflammation in the genetically susceptible host. Future directions in the IBD will likely explicate the inhomogeneous causes of these diseases, with implications for individualized therapy.

Pelvic Floor Digest

*This section presents a small sample of the Pelvic Floor Digest, an online publication (**www.pelvicfloordigest.org**) that reproduces titles and abstracts from over 200 journals. The goal is to increase interest in all the compartments of the pelvic floor and to develop an interdisciplinary culture in the reader.*

FORUM

Editor's note: importance of revealing any author conflicts of interest. *Lin K. Am Fam Physician 2007;75:472.*

Introduction to nanotechnology: potential applications in physical medicine and rehabilitation. *Gordon AT, Lutz GE, Boninger ML, Cooper RA. Am J Phys Med Rehabil 2007;86:225-41.* Nanotechnology may transform the diagnosis and treatment of disease in the 21st century through the study, design, manipulation, manufacture, and control of materials or devices by physical or chemical means at resolutions in the order of one billionth of a meter. The review discusses potential developments in tissue engineering, drug delivery, imaging, diagnostics, surface texturing, and biointerfaces that could impact the practice of medicine.

1 – THE PELVIC FLOOR

Marketed vaginal mesh kits: rampant experimentation or improved quality of care? : Thoughts following the 2006 AUGS meeting by AUGS president Ingrid Nygaard, M.D. *Nygaard I. Int Urogynecol J Pelvic Floor Dysfunct 2007;18:483-4.*

Effects of aging on lower urinary tract and pelvic floor function in nulliparous women. *Trowbridge ER, Wei JT, Fenner DE, Ashton-Miller JA, Delancey JO. Obstet Gynecol. 2007;109:715-720.* To evaluate the effects of aging, independent of parity, on pelvic organ and urethral support, urethral function, and levator function, 82 nulliparous women (21-70 years) underwent pelvic examination using pelvic organ prolapse quantification, urethral angles by cotton-tipped swab, and multichannel urodynamics and uroflow. Vaginal closure force was quantified using an instrumented vaginal speculum. Increasing age was associated with decreasing maximal urethral closure pressure with a 15-cm-H2O decrease in pressure per decade. Pelvic organ support as measured by POPQ and levator function did not differ by age group.

2 – FUNCTIONAL ANATOMY

Histological features of the rectovaginal septum in elderly women and a proposal for posterior vaginal defect repair. *Nagata I, Murakami G, Suzuki D et al. Int Urogynecol J Pelvic Floor Dysfunct 2007 Mar 1; Epub.* To develop a novel surgical procedure for posterior vaginal defect repair, the rectum-vagina interface tissues obtained from 20 elderly cadavers were examined histologically. The rectovaginal septum was defined as an elastic fiber-rich plate along the vaginal wall, lining the posterior surface of the vein-rich zone and extending between the bilateral paracolpums. The septum, often thin and interrupted, was more evident in the lower half of the interface. In the upper vagina augmentation using some implant is then considered to be necessary for the enterocele and high rectocele.

Regulation of MMP-1 by sex steroid hormones in fibroblasts derived from the female pelvic floor. *Zong W, Zyczynski HM, Meyn LA et al. Am J Obstet Gynecol 2007;196:349.e1-11.* To investigate the effect of sex steroid hormones on the overall expression profile of cellular matrix metalloproteinase-1 (MMP-1) in fibroblasts derived from arcus tendineus fasciae pelvis, a premenopausal woman and a postmenopausal woman undergoing a prolapse repair were treated with physiologic concentrations of 17-beta-estradiol (E2), progesterone, E2 plus progesterone, and E2 plus ICI 182,780. Cellular expressions of the latent, active, and fragment forms of MMP-1 were analyzed and the latent and fragment forms were increased by E2, progesterone, and E2 plus progesterone, while the active form was not changed by either E2 or progesterone alone but was decreased significantly when both hormones were added together. ICI 182,780 inhibited the stimulatory effect of E2. Both E2 and progesterone are necessary to maintain the integrity of female pelvic floor.

3 – DIAGNOSTICS

Impact of lower urinary tract symptoms on quality of life using Functional Assessment Cancer Therapy scale. *Batista-Miranda JE, Molinuevo B, Pardo Y.Urology 2007;69:285-8.* In male patients LUTS have considerable impact on the general well-being. Combined with age, they can explain up to 30% of the variance in QOL. Nocturia and incomplete emptying are the most troublesome symptoms.

Validating a clinical measure of levator hiatus size. *Boyles SH, Edwards SR, Gregory WT et al. Am J Obstet Gynecol 2007;196:174.e1-4.* The interrater reliability of levator hiatus (LH) size was evaluated and correlated to other measures of muscle function. During maximal contraction of the levator ani, the muscle was assessed independently by 2 examiners by using Brink's scale. The LH was measured in the transverse and sagittal dimensions by digital palpation. The mean LH transverse was 4.5 cm and the mean LH sagittal was 3 cm with a good interrater reliability.

Quantification of major morphological abnormalities of the levator ani. *Dietz HP. Ultrasound Obstet Gynecol 2007;29:329-34.* A quantification of morphological abnormalities of the levator ani found in a significant minority of women presenting with symptoms of pelvic floor dysfunction was attempted using tomographic 3D translabial pelvic floor ultrasound in 262 consecutive women referred for complaints of lower urinary tract dysfunction and prolapse. Main outcome measures were craniocaudal and ventrodorsal extent of defects of the pubovisceral muscle. Avulsion injuries were diagnosed in 19% of the women, 21.3% of the vaginally parous. Defects were found unilaterally and bilaterally. Hiatal area on Valsalva was correlated weakly with defect score and total defect width. Defect score and maximum width were significantly higher in women with prolapse.

Rectal cooling test in the differentiation between constipation due to rectal inertia and anismus. *Shafik A, Shafik I, El Sibai O, Shafik AA. Tech Coloproctol 2007;11:39-43.* The differentiation between constipation due to rectal inertia and that due to outlet obstruction from non-relaxing puborectalis muscle is not easily achieved with one diagnostic test. Rectal infusion with iced saline increased rectal tone in healthy controls and constipated patients with anismus while it had no effect in the remaining patients. Lack of increase of rectal tone may be secondary to rectal inertia. Therefore the test can effectively differentiate between the two forms of constipation.

High-resolution manometry in the evaluation of anorectal disorders: a simultaneous comparison with water-perfused manometry. *Jones MP, Post J, Crowell MD. Am J Gastroenterol 2007;102:850-5.* High-resolution manometry combined with novel interpretive software allows for the interpolation of manometric recordings into highly detailed topographical plots of intraluminal pressure events relative to time and location, providing, in patients with constipation, incontinence, and fecal soilage greater resolution of the intraluminal pressure environment of the anorectum compared to water-perfused manometry.

Intermittent bowel obstruction due to a retained wireless capsule endoscope in a patient with a small bowel carcinoid tumour. *Strosberg JR, Shibata D, Kvols LK. Can J Gastroenterol 2007;21:113-5.* Two years after undergoing a wireless capsule endoscopy procedure, radiological examinations revealed a retained capsule endoscope causing partial small bowel obstruction. The capsule was retrieved through laparotomy.

Nurses working in GI and endoscopic practice: a review. *Verschuur EM, Kuipers EJ, Siersema PD. Gastrointest Endosc 2007;65:469-479.* Nurses increasingly perform tasks and procedures that were previously performed by physicians. The findings of this review support the involvement of nurses in diagnostic endoscopy and follow-up of patients with chronic GI disorders. Further randomized trials, however, are needed to demonstrate whether this involvement compares at least as favorably with gastroenterologists in terms of medical outcomes, patient satisfaction, and costs.

4 – PROLAPSES

Pelvic organ prolapse. *Jelovsek JE, Maher C, Barber MD. Lancet 2007;369:1027-38.* A complete review on pelvic organ prolapse. Many women with pelvic organ prolapse are asymptomatic and do not need treatment. When prolapse is symptomatic, options include observation, pessary use, and surgery. Radiographic assessment is usually unnecessary. Surgical strategies for prolapse can be categorised broadly by reconstructive and obliterative techniques. No effective prevention strategy for prolapse has been identified.

Natural history of pelvic organ prolapse in postmenopausal women. *Bradley CS, Zimmerman MB, Qi Y, Nygaard IE. Obstet Gynecol 2007;109:848-854.* To describe the natural history of pelvic organ prolapse and risk factors for changes in vaginal descent in older women, a 4-year prospective observational study included 259 postmenopausal women with the uterus. Prolapse progresses and regresses in older women, although rates of vaginal descent progression are slightly greater than regression overall. Obesity and grand multiparity are risk factors for progression.

Sonomorphological evaluation of polypropylene mesh implants after vaginal mesh repair in women with cystocele or rectocele. *Tunn R, Picot A, Marschke J, Gauruder-Burmester A. Ultrasound Obstet Gynecol 2007;29:449-52.* To investigate whether the sonographically measured size of the mesh implant, after 6 weeks correlates with the original size, and whether the mesh ensures complete support of the anterior (transobturator implant) or posterior (transischioanal implant) compartment, 40 postmenopausal women with cystocele or rectocele were evaluated with introital ultrasound. The mesh supported 43.4% of the length of the anterior and 53.7% of the posterior vaginal wall. There is a considerable discrepancy between the implanted mesh size and the length measured 6 weeks later.

New technique for the repair of anterior pelvic floor compartment defects using a synthetic implant with biological coverage: approach, fixation and transobturator anchoring. *Moreno Sierra J, Prieto Nogal SB, Galante Romo MI et al. Arch Esp Urol 2007;60:45-50.* Transobturator systems for anterior vaginal wall prolapse repair may be considered an approach and also a mesh fixation system, in opposition to free mesh cystocele repair where they work by the creation of fibrotic tissue after biological or synthetic mesh implant. The design and technology of the Avaulta anterior system is described, which exemplifies the current trend in pelvic floor surgery.

Uncontrollable intra-abdominal bleeding necessitating low anterior resection of the rectum after stapled hemorrhoidopexy: report of a case. *Blouhos K, Vasiliadis K, Tsalis K et al. Surg Today 2007;37:254-7.* One of the most serious complications of stapled hemorrhoidopexy is severe bleeding. A case of extensive hemoperitoneum without evidence of typical rectal bleeding is reported in a patient with third-degree hemorrhoids soon complaining severe abdominal pain and signs of peritonitis requiring an emergency exploratory laparotomy, which revealed extensive hemoperitoneum and a devitalized edematous rectum with a tense hematoma, 1 cm above the staple line. A low anterior resection was performed.

Stapled hemorrhoidopexy height as outcome indicator. *Williams R, Kondylis L, Geisler D, Kondylis P. Am J Surg 2007;193:336-9.* Postoperative expectations after stapled hemorrhoidopexy are still being clarified. To evaluate how outcome is affected by staple line height above the dentate line and specimen histology, 105 patients were analyzed, concluding that staple line height and histology can impact postoperative outcomes: the height should be >20 mm yet < or =40 mm above the dentate, avoiding squamous epithelium.

Delayed presentation of life-threatening perineal sepsis following stapled haemorrhoidectomy: a case report. *McCloud JM, Doucas H, Scott AD, Jameson JS. Ann R Coll Surg Engl 2007;89:301-2.* There have been several cases of Fournier's gangrene following stapled haemorrhoidopexy. A case in which this complication appeared 39 days after the operation is described. The patient recovered after wide tissue excision and fashioning of a colostomy.

5 – RETENTIONS

Use of nomogram to predict acute urinary retention. *Tang VC, Bott SR. Ann R Coll Surg Engl 2007;89:192.*

Tension-free vaginal tape: poor intraoperative cough test as a predictor of postoperative urinary retention. *Takacs P, Medina CA. Int Urogynecol J Pelvic Floor Dysfunct 2007 Mar 30; Epub.*

A randomized, multicenter, placebo-controlled trial of polyethylene glycol laxative for chronic treatment of chronic constipation. *Dipalma JA, Cleveland MV, McGowan J, Herrera JL. Am J Gastroenterol 2007 Mar 31; Epub.* Polyethylene glycol is currently approved for the short-term treatment of occasional constipation. This study was designed to compare the safety and efficacy of this laxative versus placebo over a 6-month treatment period in patients with chronic constipation: It proved to be safe and effective.

A washing toilet seat with a CCD camera monitor to stimulate bowel movement in patients with spinal cord injury. *Uchikawa K, Takahashi H, Deguchi G, Liu M. Am J Phys Med Rehabil 2007;86:200-4.* The effectiveness of a modified washing toilet seat equipped with a CCD camera monitor and an electronic bidet to facilitate precise hitting of the anal area with water streams to stimulate bowel movement in patients with traumatic spinal cord injury (SCI), was studied in 20 subjects at least 5 mos post acute injury. Bowel movement was successfully induced in 75% of the patients. Success was not related significantly to injury level, ASIA impairment scale, or ability to voluntarily squeeze. Compared with their usual manner of bowel management, for which they spent more than 30 mins, time needed for successful bowel movement was shortened without any complication.

Patients with functional constipation do not have increased prevalence of colorectal cancer precursors. *Chan AO, Hui WM, Leung G et al. Gut 2007;56:451-2.*

6 – INCONTINENCES

Postpartum depression, urge urinary incontinence, and overactive bladder syndrome: is there an association? *Hullfish KL, Fenner DE, Sorser SA et al. Int Urogynecol J Pelvic Floor Dysfunct 2007 Feb 17; Epub.* In this cross-sectional study an association between postpartum depression and symptoms of urge incontinence was found. Type of delivery, vaginal vs cesarean section, did not significantly impact the urge scores. Because birth is a predictable event, further studies evaluating the causal relationships and physiologic changes linking depression and incontinence can be studied using this model.

Experimental animal model for training transobturator and retropubic sling techniques. *Riccetto CL, Palma PC, Thiel M et al. Urol Int 2007;78:130-4.* Suburethral transobturator slings have become the treatment of choice for stress urinary incontinence, but the lack of experimental models for surgical training is a problem for beginners. An animal model (11-month-old Santa Ines sheep) for sling training is presented. As far as anatomical similarities of vaginal structures, cystoscopy and transvaginal sling 97% of 32 surgeons reported similarities or a strong correlation.

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Significance of tension in tension-free mid-urethral sling procedures: a preliminary study. *Paick JS, Oh JG, Shin JW et al. Int Urogynecol J Pelvic Floor Dysfunct 2007;18:153-8.* The results of the release and tape-shortening techniques in polypropylene pubovaginal mid-urethral slings are reported, tension playing a substantial role in restoring continence or experiencing urinary retention or other voiding difficulties.

13 years of experience with artificial urinary sphincter implantation at Baylor College of Medicine. *Lai HH, Hsu EI, Teh BS et al. J Urol 2007;177:1021-5. Between 1992 and 2005,* 270 patients underwent artificial urinary sphincter implantation (single surgeon). Of the 218 patients followed-up 176 underwent underwent prostatectomy with or without pelvic radiation, 11 had neurogenic bladder and 31 underwent secondary artificial urinary sphincter implantation. Complication rates were infection in 5.5% of cases, erosion in 6.0%, urethral atrophy in 9.6%, mechanical failure in 6.0% and surgical removal or revision in 27.1%. At 5 years 75% of patients had avoided revision or removal.

Physical activity and urinary incontinence among healthy, older women. *Danforth KN, Shah AD, Townsend MK et al. Obstet Gynecol 2007;109:721-727.* Physical activity is associated with a significant reduction in urinary incontinence. Results appear somewhat stronger for stress than urge UI.

Complications of sling surgery among female medicare beneficiaries. *Anger JT, Litwin MS, Wang Q et al. Obstet Gynecol 2007;109:707-14.* Complication rates within 1 year after sling surgery among Medicare beneficiaries were found to be higher than those reported in the clinical literature. The high rates of postoperative urinary tract infections, prolapse, and outlet obstruction suggest the need for quality improvement measures in the management of women with incontinence and pelvic prolapse.

Anatomic comparison of two transobturator tape procedures. *Zahn CM, Siddique S, Hernandez S, Lockrow EG. Obstet Gynecol 2007;109:701-6.* To compare outside-in (Monarc) and inside-out (TVT-O) methods for transobturator tape placement regarding proximity of the tape to the obturator canal and ischiopubic ramus, 7 cadavers were dissected to the level of the obturator membrane measuring the distance from the closest aspect of the obturator canal and ischiopubic ramus to each tape. The outside-in technique results in the mesh being placed farther from the obturator canal and closer to the ischiopubic ramus, theoretically reducing the risk of neurovascular injury.

Comparison of cystographic findings of intrinsic sphincteric deficiency with urethral hypermobility causing urinary incontinence. *Park SW, Sung DJ, Choi EJ et al. Urol Int 2007;78:116-20.* Intrinsic sphincter deficiency should be considered in female patients with symptoms of urinary incontinence where there are changes in posterior urethrovesical angle <20 degrees on a lateral cystogram between a stress state and resting state in addition to the beaking sign of the vesical neck during a resting state.

Sacral nerve stimulation for neurogenic faecal incontinence. *Holzer B, Rosen HR, Novi G et al. Br J Surg 2007 Apr 4; Epub.* Thirtysix patients with faecal incontinence of neurological aetiology were included in a trial of SNS and 29 had a permanent implant. Evaluation consisted of a continence diary, anal manometry, saline retention testing and quality of life assessment. After a median follow-up of 35 (range 3-71) months, 28 patients showed a marked improvement or complete recovery of continence. Saline retention time increased from a median of 2 (0-5) to 7 (2-15) min. Maximum resting and squeeze anal canal pressures, and quality of life on all scales, increased at 12 and 24 months after operation.

Internal anal sphincter defect influences continence outcome following obstetric anal sphincter injury. *Mahony R, Behan M, Daly L et al. Am J Obstet Gynecol 2007;196:217.e1-5.* To define the correlation between the extent of anal sphincter injury as seen by endoanal ultrasound and symptoms of postpartum fecal incontinence, 500 women were studied at 3 months following primary repair of a first recognized obstetric anal sphincter injury during vaginal delivery. US evidence of internal anal sphincter injury is predictive of severe incontinence (score greater than 9/20).

National audit of continence care for older people: management of faecal incontinence. *Potter J, Peel P, Mian S et al. Age Ageing 2007 Mar 13; Epub.* Faecal incontinence in older people is associated with considerable morbidity but is amenable to successful management. Basic assessment and care for truly integrated continence services by the professionals directly looking after older persons however is often lacking and there is an urgent need to re-establish the fundamentals of continence care into the daily practice of medical and nursing staff.

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7 – PAIN

Chronic prostatitis/chronic pelvic pain syndrome: role of alpha blocker therapy. *Lee SW, Liong ML, Yuen KH et al. Urol Int 2007;78:97-105.* Encouraging results in uncontrolled and small clinical trials led to the development of reasonably powered, double-blinded, placebo-controlled, randomized clinical trials evaluating terazosin, doxazosin, tamsulosin, and alfuzosin for chronic prostatitis/chronic pelvic pain syndrome (CP/CPPS), the most common and difficult prostatitis syndrome. Treatment-naive and/or newly diagnosed patients appear more likely to respond than long-term, chronic refractory patients.

Assessment of vulvodynia symptoms in a sample of US women: a prevalence survey with a nested case control study. *Arnold LD, Bachmann GA, Rosen R, Rhoads GG. Am J Obstet Gynecol 2007;196:128.e1-128.e6.* Vulvodynia is a chronic pain syndrome of unknown origin with scant data on frequency. A phone survey contacted 2127 US households to identify 100 symptomatic women. Current vulvar pain of at least 6 months duration was reported by 3.8% of respondents, with a 9.9% lifetime prevalence. Forty-five percent of women with pain reported an adverse effect on their sexual life and 27% an adverse effect on their lifestyle.

Limbic associated pelvic pain: A hypothesis to explain the diagnostic relationships and features of patients with chronic pelvic pain. *Fenton BW. Med Hypotheses 2007 Feb 8; Epub.* Limbic associated pelvic pain is a proposed pathophysiology designed to explain features commonly encountered in patients with chronic pelvic pain, including the presence of multiple pain diagnoses (endometriosis, interstitial cystitis, irritable bowel syndrome, levator ani syndrome, pelvic floor tension myalgia, vestibulitis, vulvodynia). This may occur in patients with chronic pelvic pain out of proportion to any demonstrable pathology (hyperalgesia) and with more than one demonstrable pain generator (allodynia). Chronic stimulation of the limbic system (anterior cingulate cortex, hippocampus and amygdala) by pelvic pain afferents produces an efferent contraction of the pelvic muscles, thus perpetuating the cycle.

Fatigue in irritable bowel syndrome: characterization and putative role of leptin. *Piche T, Huet PM, Gelsi E et al. Eur J Gastroenterol Hepatol 2007;19:237-43.* Fatigue occurs in 62.7% of irritable bowel syndrome patients if asked for, and influences all domains of the Fatigue Impact Scale, mostly the physical and the psychosocial domains. Fatigue is associated with circulating leptin levels independent from age, sex and BMI. The metabolic sequence involved in the occurrence of fatigue is to be determined.

The cognitive behavioural model of irritable bowel syndrome: a prospective investigation of gastroenteritis patients. *Spence MJ, Moss-Morris R. Gut 2007 Feb 26; Epub.* To determine whether a combination of mood and personality factors together with illness beliefs and behaviours predict the onset of irritable bowel syndrome post gastroenteritis, 49 patients were studied, those with high stress and anxiety levels being more prone to develop IBS after a bout of gastroenteritis. Additional risk factors include a tendency to interpret illness in a pessimistic fashion and to respond to symptoms in an all- or-nothing manner.

Probiotics and irritable bowel syndrome: a rationale for their use and an assessment of the evidence to date. *Quigley EM, Flourie B. Neurogastroenterol Motil 2007;19:166-72.* Probiotics, defined as live organisms that, when ingested in adequate amounts, exert a health benefit on the host, have been used for almost a century in the management of a variety of medical disorders, usually on the basis of little evidence. Advances in our understanding of the gut flora and of its relationship to the host, have identified their important role in the post-infective variety of IBS.

Role for protease activity in visceral pain in irritable bowel syndrome. *Cenac N, Andrews CN, Holzhausen M et al. J Clin Invest 2007;117:636-647.* Proteases are released in IBS and can directly stimulate sensory neurons and generate hypersensitivity symptoms through the activation of protease-activated receptor-2.

The degree of breath methane production in IBS Correlates with the severity of constipation. *Chatterjee S, Park S, Low K et al. Am J Gastroenterol 2007;102:837-41.* Among IBS subjects, methane on lactulose breath test is associated subjectively and objectively with constipation predominance, and the degree of methane production is related to the degree of constipation.

Immune activation in patients with irritable bowel syndrome. *Liebregts T, Adam B, Bredack C et al. Gastroenterology 2007;132:913-20.* To test the hypothesis that IBS is characterized by an augmented cellular immune response with enhanced production of proinflammatory cytokines, and to explore whether symptoms and psychiatric comorbidity in IBS are linked to the release of proinflammatory cytokines, 55 patients (18 mixed-, 17 constipation-, 20 diarrhea-predominant) were studied, and patients with D-IBS display enhanced proinflammatory cytokine release, this being associated with anxiety.

Morphological analysis of human acupuncture points through immunohistochemistry. *Wick F, Wick N, Wick MC. Am J Phys Med Rehabil 2007;86:7-11.*

8 – FISTULAE

Treatment of refractory urethrovaginal fistula using rectus abdominis muscle flap in a six-year-old girl. *Atan A, Tuncel A, Aslan Y. Urology 2007;69:384.e11-3.* Urethrovaginal fistula usually occurs after urethrovaginal injury, resulting in urinary incontinence. The rectus abdominis muscle flap was used in a 6-year-old girl with refractory urethrovaginal fistula.

The Addis Ababa fistula hospital: an holistic approach to the management of patients with vesicovaginal fistulae. *Williams G. Surgeon 2007;5:54-7.* Ethiopia is amongst the world's poorest countries. It is estimated that approximately 30,000 women have an untreated, neglected, vesicovaginal fistula. The Fistula Hospital in Addis Ababa in Ethiopia, founded in 1975 and run entirely by charitable donations, is dedicated exclusively to the care of women with obstetric fistulae, and the treatment of other physical and social injuries they have sustained.

Perianal fistulas in Crohn's disease: MRI diagnosis and surgical planning : MRI in fistulazing perianal Crohn's disease. *Szurowska E, Wypych J, Izycka-Swieszewska E. Abdom Imaging 2007 Mar 3; Epub.*

Perianal mucinous adenocarcinoma arising from chronic anorectal fistulae: a review from a single institution. *Ong J, Jit-Fong L, Ming-Hian K et al. Tech Coloproctol 2007;11:34-8.* Mucinous adenocarcinoma arising from a chronic anorectal fistula is rare, with few reports in the literature. A high index of clinical suspicion is required to make the diagnosis of perianal tumours while assessing patients presenting with perianal inflammatory conditions. Abdominoperineal resection is the surgical treatment of choice and can provide good long-term results in patients with localized disease.

9 – BEHAVIOUR, PSYCHOLOGY, SEXOLOGY

Complications and Sexual Function After Vaginectomy for Anorectal Tumors. *Hendren SK, Swallow CJ, Smith A et al. Dis Colon Rectum 2007 Feb 15; Epub.* Among 54 patients who underwent vaginectomy during anorectal tumor resection 19 had flap reconstruction of the vagina and 35 had primary repair, 83% experienced surgical complications. Twenty-three patients completed a questionnaire: only 6 were able to have sexual intercourse. No living patients who had flap reconstruction were able to have sexual intercourse. Only 20 percent of patients remembered a preoperative discussion of possible sexual effects of surgery; however, overall quality of life was preserved.

Sildenafil citrate improves erectile function and urinary symptoms in men with erectile dysfunction and lower urinary tract symptoms associated with benign prostatic hyperplasia: a randomized, double-blind trial. *McVary KT, Monnig W, Camps JL Jr et al. J Urol 2007;177:1071-7.* Improved erectile dysfunction and lower urinary tract symptoms with sildenafil in men with the 2 conditions were associated with improved quality of life and treatment satisfaction. Daily dosing with sildenafil may improve lower urinary tract symptoms. However, the lack of effect on urinary flow rates may mean that a new basic pathophysiology paradigm is needed to explain the etiology of lower urinary tract symptoms.

The psychological burden of premature ejaculation. *Rowland DL, Patrick DL, Rothman M, Gagnon DD. J Urol 2007;177:1065-70.* Premature ejaculation (latency time of 2 minutes or less) has a significant psychological burden on men, their partners and the male/partner relationship.

Evaluation of sexual function in women with overactive bladder syndrome. *Sen I, Onaran M, Tan MO et al. Urol Int 2007;78:112-5.* Women with OAB were divided into wet and dry groups. Scores of all domains (desire, arousal, lubrication, orgasm, satisfaction, pain and total) were found to be lower than in the control group, only 'desire' was found to be significantly different.

Sexual function after tension-free vaginal tape procedure. *Marszalek M, Roehlich M, Racz U et al. Urol Int 2007;78:126-9.* Among 52 women after a TVT procedure 74.0% indicated that they became totally continent. One third of the sexually active women reported an improvement of their sexual life, 14.3% a worsening, and 52.4% no change. Deterioration of sexual function was significantly associated with de novo urge, dyspareunia and sensation of postvoid residual urine volume. In summary the influence of the TVT procedure on female sexual function is evident, but of low impact, and in general will not be of relevance.

GPs' perception of their role in the identification and management of family violence. *Miller D, Jaye C. Fam Pract 2007;24:95-101.* The GPs' estimation of family violence prevalence in their practices is low compared to community-based research. Many issues affect the GP in identifying and managing family violence and must be considered in developing guidelines and training, referral systems and support.

Erectile dysfunction correlates with left ventricular function and precedes cardiovascular events in cardiovascular high-risk patients. *Baumhakel M, Bohm M. Int J Clin Pract 2007;61:361-6.* Erectile dysfunction (ED) is related to cardiovascular risk factors by an impairment of endothelial function, therefore, this symptom is probably to precede cardiovascular disease and events, and cardiovascular evaluation is recommended in patients with ED providing the opportunity of optimised preventional treatment.

Phalloplasty and urethroplasty in children with penile agenesis: preliminary report. *De Castro R, Merlini E, Rigamonti W, Macedo A Jr. J Urol 2007;177:1112-6.* Patients affected by penile agenesis, are better raised according to their karyotype and hormonal production, and opposite gender should not be assigned. Definitive phalloplasty in adults may achieve good results. Nevertheless, this procedure is generally performed in postpubertal boys and it is not easily available everywhere.

An evolutionary interpretation of the significance of physical pain experienced by human females: Defloration and childbirth pains. *Maul A. Med Hypotheses 2007 Feb 16; Epub.* The phenomena surrounding the pains related to first coitus and delivery have been poorly investigatedn in human sexuality and reproductive behavior as regards their evolutionary aspects. In particular the function of the hymen and the significance of defloration are largely misunderstood. Childbirth and defloration pains are hypothesized to manifest an adaptation designed to increase inclusive fitness in human evolutionary history, the significance of pain as a message being essentially emotional. The intense sexual emotions that may precede and follow the pain, the breaking and bleeding of the hymen, may generate strong feelings in the newly formed couple, and the labor pain may create mutual solicitude among the protagonists (imidwifes, father, mother) beneficial to all of them, and more particularly to the newborn. These behavioral implications may increase the stability of the connection between partners and indirectly to the survival, especially in former times, of the child.

Woman with incontinence and a history of childhood sexual abuse. *Wallace JD. Urol Nurs 2007;27:38-9.*

10 – MISCELLANEOUS

Immediate postoperative complications of combined penetrating rectal and bladder injuries. *Crispen PL, Kansas BT, Pieri PG et al. J Trauma 2007;62:325-9.* Combined penetrating trauma involving the rectum and bladder has been associated with increased postoperative complications: colovesical fistula, urinoma, abscess formation. Isolated rectal (29), isolated bladder (16), or combined injury (24) were compared. Presacral drainage was utilized in all patients with extraperitoneal injuries. Fecal diversion was performed in all patients, except two with intraperitoneal rectal injuries. Omental flap interposition between rectal and bladder injuries was utilized in one patient. No significant difference was noted in immediate postoperative complications between groups, however, all cases of colovesical fistula (2) and urinoma (2) formation were noted in those patients with rectal and posterior bladder injuries. Consequently, these patients may benefit from omental flap interposition between injuries.

Rokitansky syndrome: clinical experience and results of sigmoid vaginoplasty in 23 young girls. *Khen-Dunlop N, Lortat-Jacob S, Thibaud E et al. J Urol 2007;177:1107-11.* Sigmoid vaginoplasty provides a functional self-lubricating neovagina and is a valuable procedure recommended during adolescence because the local conditions are excellent and it allows adaptation of the anatomy to physical development.

Urinary tract injuries during obstetrics and gynaecological surgical procedures at the Aga Khan University Hospital Karachi, Pakistan: a 20-year review. *Nawaz FH, Khan ZE, Rizvi J. Urol Int 2007;78:106-11.*

The posterior urethra in anorectal malformations. *Mickelson JJ, Macneily AE, Blair GK. J Pediatr Surg 2007;42:585-7.*

Lateral internal sphincterotomy is superior to topical nitroglycerin for healing chronic anal fissure and does not compromise long-term fecal continence: six-year follow-up of a multicenter, randomized, controlled trial. *Brown CJ, Dubreuil D, Santoro L, Liu M, O'connor BI, McLeod RS. Dis Colon Rectum 2007 Feb 13;. Epub.*

Relaxation of the isolated human internal anal sphincter by sildenafil. *Ballester C, Sarria B, Garcia-Granero E et al. Br J Surg 2007 Mar 5; Epub.* The relaxant effects of sildenafil, a selective phosphodiesterase 5 (PDE5) inhibitor, supports its potential use in the treatment of chronic anal fissure.

Inflammatory bowel disease: past, present, and future. *Sands BE. J Gastroenterol 2007;42:16-25.* Crohn's disease and ulcerative colitis (IBD), are associated with the rise of modern, westernized industrial society. Although the causes of these diseases remain incompletely understood, the prevailing model is that the intestinal flora drives an unmitigated intestinal immune response and inflammation in the genetically susceptible host. Future directions in the IBD will likely explicate the inhomogeneous causes of these diseases, with implications for individualized therapy.

Editorial

Welcome to Pelviperineology. This is not a new journal. It began life in 1982 and for some years it provided a truly multidisciplinary forum for pelvic medicine and surgery in Italy. Pelviperineology is now also the official journal of the Australian Association of Vaginal and Incontinence Surgeons (AAVIS), the Integrated Pelvis Group and the Indonesian Society of Female Pelvic Floor Disfunction.

AAVIS is a multidisciplinary pelvic floor society founded in 1996. Initially it was a support group for the surgeons who were the first in the world to adopt the paradigm of Petros and Ulmsten and perform the tension free suburethral intravaginal slingplasty (IVS) procedures. The IVS was the beginning of a revolution in pelvic medicine. Advances in our understanding of anatomy and physiology and the development of surgical prostheses have provided new options for pelvic surgeons. From the IVS developed the Tension Free Tape (TVT) and in just a few short years over 50 prostheses have appeared to treat genital prolapse and urinary incontinence.

Around the world urologists, gynaecologists, urogynaecologists, proctologists and colorectal surgeons have worked independently in the pelvis. The colorectal surgeons often felt that the posterior compartment had been neglected by the other specialties. Whilst inspiring stories of collaboration exist in some places, communication between these groups was often absent so that diverse attitudes and separate bodies of knowledge have developed. Meanwhile a revolution was also happening in laparoscopic surgery and some surgeons were advocating a minimally invasive laparoscopic approach for every clinical situation. Traditional skills became less important as the focus shifted to endoscopy. A generation of older surgeons, sometimes disenfranchised as the leaders of their profession, struggled to keep up with the new developments. In gynaecology vaginal surgery seemed less relevant but a small group of surgeons were trying to preserve and promote vaginal surgery skills. Now some urologists and even some colorectal surgeons are interested in vaginal surgery as they have seen that the vagina can offer good access to the pelvis.

The Integrated Pelvis Group (IPG) considers the pelvis as a unit. The IPG is an example of how groups of doctors from different disciplines can work together to share knowledge, improve their skills and collaborate in research and training. The IPG is a new concept in communication. It is not another society. There are no fees, no formal meetings and no policies. We hope to bring as many diverse opinions together and work with the existing societies. Specialists of any field are welcome to join the group and this journal will become their voice. Pelviperineology will be published on the Internet and we hope it can become an important source of information for clinicians. The online connection with the Pelvic Floor Digest (www.pelvicfloordigest.org) and the related digest section in each issue will provide an important education resource and emphasises the commitment of the IPG to medical education. One of the aims of the IPG is to transform the management of pelvic floor problems from a multidisciplinary to an interdisciplinary approach. This journal will emphasise the integration of the three compartments of the pelvis as a single functional unit with a shared central cortical control system. Psychological factors, life experiences, sexual problems and the effects of hormones combine to create a complex matrix that we cannot hope to interpret or understand if we work alone.

Pelviperineology will seek to explore the integrated pelvis and publish articles from both the four corners of the world and the three compartments of the pelvis. We hope this journal can be free of politics and so rise above the self interest of any particular group. We will try to achieve this by being open to diverse views and consider alternative solutions when we can find them. We hope you can join us on this journey.

THE EDITORS

Review

Recto-enterocoele repair: past problems and new horizons

RICHARD REID

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Abstract: Standard operations for treatment of recto-enterocoele are based on incorrect anatomical assumptions from the past. The anatomy of prolapse and the principles of hernia repair are reviewed. A new concept of the dynamic bridging graft is proposed.

Key words: Recto-enterocoele; Hernia principles; Site specific defects; Mesh repair; Dynamic bridging grafts.

Present methods for treating recto-enterocoele are based on assumptions of 100 years ago. These assumptions are now known to be flawed. However, new anatomic and surgical insights into the pathogenesis of recto-enterocoele have not flowed on to improved therapy. Standard operations for recto-enterocoele, whether done as a posterior colporrhaphy or a Delorme's procedure, are still rooted in concepts of 20 years ago.

ERRONEOUS ASSUMPTIONS FROM THE PAST

The true basis of pelvic organ support was a complete mystery to 19th Century surgeons. The ambient belief in Victorian times was that pelvic organ support derived mainly from the stiffness of the vaginal walls, which were in turn thought to be held up by their insertion into the levator ani muscles and perineal body. Little distinction was made between prolapse of uterus, bladder or rectum. Constricting the genital hiatus and creating an obstructive shelf in the lower third of vagina was seen as a way to strengthen upper tract support (Fig. 1*a* & *b*).

However, the impression of improved uterine support after such surgery was completely erroneous. It arose because the still unsupported cervix and uterus often remained hidden within a voluminous pocket above the rigid perineal shelf, created by levatorplasty. Nonetheless, this entirely non-anatomic operation held sway until well after World War II.[1]

Beginning in the 1960's, this very deforming operation of high transverse levatorplasty began to fall into disfavour, because of its high incidence of dyspareunia [2] and because it contributed little to enterocoele repair. In a search for a less morbid technique, focus shifted to Denonvillier's fascia. This structure was first described in males, but was later recognized as having significant supportive value in women.[3] Based on the assumption that rectocoeles arose because of fascial attenuation, surgeons began plicating the central portion of the rectovaginal septum, as a potentially less morbid strategy. This surgery has been done by both the transvaginal [4] and transanal routes.[5] Direct comparison of the trans-vaginal and trans-anal approaches through the medical literature is impossible, because gynaecologists operate primarily for bulge control and colorectal surgeons operate primarily for obstructive defaecation. We know from clinical experience that both methods of rectocoele repair deliver reasonable symptom control, at least for a while. However, normal anatomy cannot be restored by either transvaginal or transanal plication.[6] Both techniques have also been largely ineffective at restoring normal defaecation mechanics,[7] and both still carry a risk of postoperative dyspareunia.[6]

Gynaecologists next turned to the concept of locating and specifically correcting any specific tears in the rectovaginal septum, as had been pre-empted by Richardson.[8] Several reports of so called "defect-specific" rectocoele repairs appeared in the American literature, citing good bulge control, better functional outcomes and much reduced dyspareunia rates.[7, 9, 10] However, the repair of these "defects" amount to nothing more than placing a finger of the non-dominant hand in the rectum at the time of surgery, and re-enforcing any area of perceived fascial weakness with isolated sutures. As explained below, this approach has failed to grasp the true nature of the "site-specific" defects that lead to recto-enterocoele formation. Not surprisingly, later reports have shown these mechanically misguided attempts at "defect-specific" rectocoele repair to be quite inefficient.[11]

If we are to achieve optimal anatomic and functional results from rectocoele repair, our surgical techniques must satisfy the principles of biomechanics. First and foremost, we must set aside the erroneous belief that rectocoele arises because of fascial attenuation. In reality, endopelvic fascia is like canvas – it does not easily stretch, but will tear along lines of stress.[12, 13] Second, surgeons must understand the true nature of the fascial defects that cause recto-enterocoeles. The connective tissues of the postero-apical compartment form a thick and highly collagenized leash, running from sacrum to perineum (Fig. 2*a*).

This fascial aggregation plays an important support role, and has been designated the *'vaginal suspensory axis'*.[12] Obstetric damage to the vaginal suspensory axis almost always occurs in the mid-pelvis, because expulsive forces increase exponentially as the presenting part tries to negotiate the "plane of least dimensions". If the endopelvic fascia is torn as the head tries to enter the mid-pelvis ("engagement"), the upper margin of the pericervical ring is likely to separate from the uterosacral ligaments – setting the stage for a 'cervix-first' prolapse. Conversely, if damage occurs as the presenting part is *exiting* the 'plane of least dimensions' ("rotation" and "extension"), the rectovaginal septum is likely to be shorn away from the inferior border of the pericervical ring (Fig. 2*b*).

The fetal head then pushes the detached rectovaginal septum downwards and outwards, much like a snow plough (Fig 3).

This injury creates a low pressure zone in the upper vagina, into which the pelvic contents can herniate, driven by sustained intra-abdominal pressure:

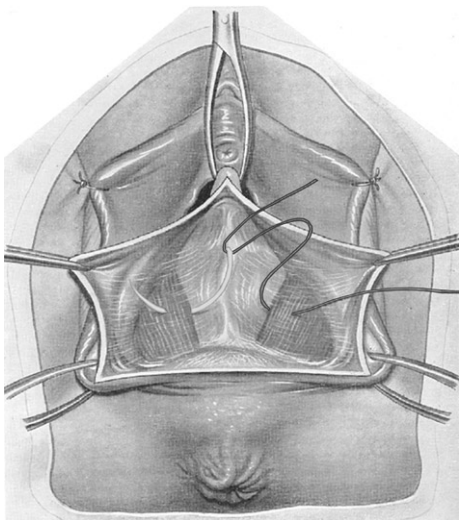
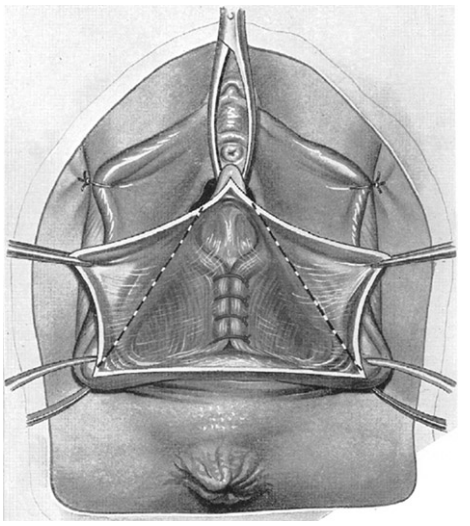
– Loss of the stiffening effect of an intact rectovaginal septum allows the rectal wall to bulge forwards. Anatomically, this creates the bulge of a rectocoele (Fig. 4*a*).

– Functionally, stool wedges in the resulting "bowel pocket", thus disrupting the mechanics of defaecation (Fig. 4*b*).

– With careful dissection, the apical edge of this detachment can usually be seen in the lower vagina (Fig. 4*c*).

– Pre-peritoneal fat is invariably found above the line of septal avulsion – a sure sign of accompanying enterocoele or sigmoidocoele (Fig. 4*d*).

Conflict of Interest Declaration: The author is supervising investigator for a global multicentre randomized clinical trial comparing 'suture-only' and SurgiSIS®-augmented vaginal paravaginal repair. Beyond this research funding from Cook Incorporated, I have no commercial or employment ties to any company.

a   b

Figs. 1*a* & 1*b*. – Depict the reparative concepts of pre WWII surgeons, based on the belief that the uterus was basically "propped up" by the walls of a stiff vaginal tube. As shown in this diagram, modified from Wilfred Shaw's textbook of 1935, prolapse repair in this era concentrated on constricting the genital hiatus and creating a rigid perineal shelf. The belief that this anatomically inappropriate technique was an effective means of supporting upper tract was entirely illusory. In reality, the prolapsing uterus and/or enterocoele simply dangled 'out of sight', in an artificial pocket that formed above the perineal shelf. What was not illusory, however, is the severe dyspareunia that high transverse levator-plasty caused.

WHY HAS PROLAPSE REPAIR BEEN SO INHERENTLY DIFFICULT?

The key reason is that *pelvic connective tissues are NOT structurally suited to chronic load bearing*. Hence, Nature relies upon a complex inter-relationship between the muscles and the connective tissues (Fig. 5).

– Pelvic floor muscles act as a dynamic backstop, which absorbs most of the load.

– Endopelvic fascia is also important, but in a less direct way.

The role of the pelvic floor muscles

Skeletal muscle brings two unique advantages to the biomechanics of pelvic organ support: *durability* and *contractility.*

i) Durability: All biological fibres are susceptible to strain-induced fatigue fracture, unless continuously remodelled in response to every day forces. Hence, even strong connective tissue would have difficulty in passively suspending the pelvic viscera in a species of bipeds that lives for 85+ yrs. These inherent biomechanical difficulties are brought to the fore by the combined insult of aging and prior childbirth injury. Both events disrupt the vital process of collagen homeostasis, and hence amplify the tendency of fascia (especially very weak fascia) to fail over time.

Stress-strain forces also create fibre fracture in skeletal muscle. However, in contrast to fascia, microtears in the

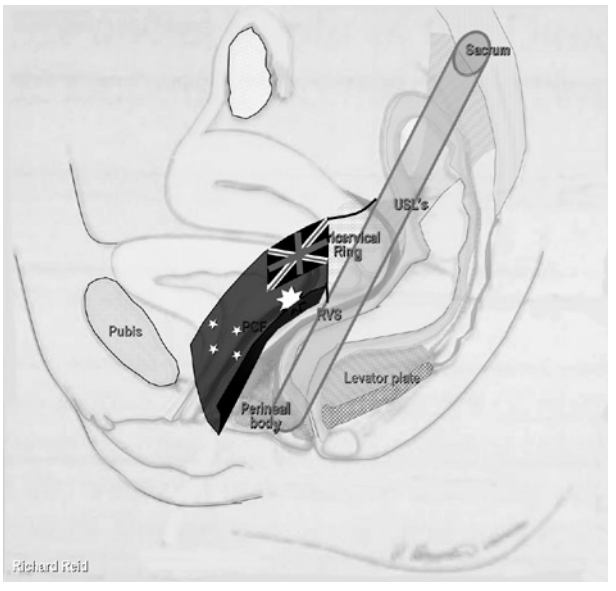


Fig. 2*a*. – A sagittal section of female pelvis, showing how the vaginal suspensory axis and the anterior vaginal hammock intersect like a flag, at half mast on a flagpole. Obstetric forces tear the fascia in the mid-pelvis (ie, where the "flag" joins the "flagpole").

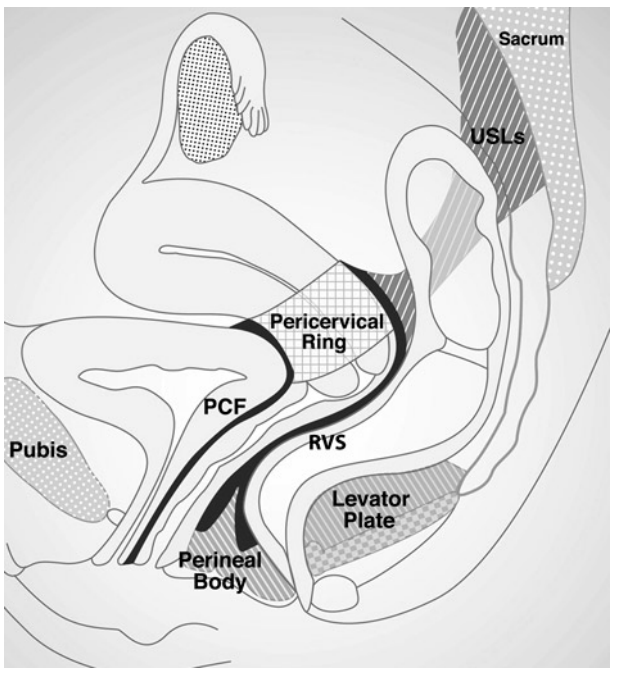


Fig. 2*b*. – The connective tissues of the postero-superior axis ("flagpole") form a continuous strong band that runs from the sacral periosteum, through the uterosacral ligaments, into the pericervical ring, and down through the rectovaginal septum, to insert into the perineal body. When this is intact, bowel motions are guided smoothly through the pelvis and easily out the anus. However, when it is torn, pelvic dragging discomfort and obstructive defecation become a problem.

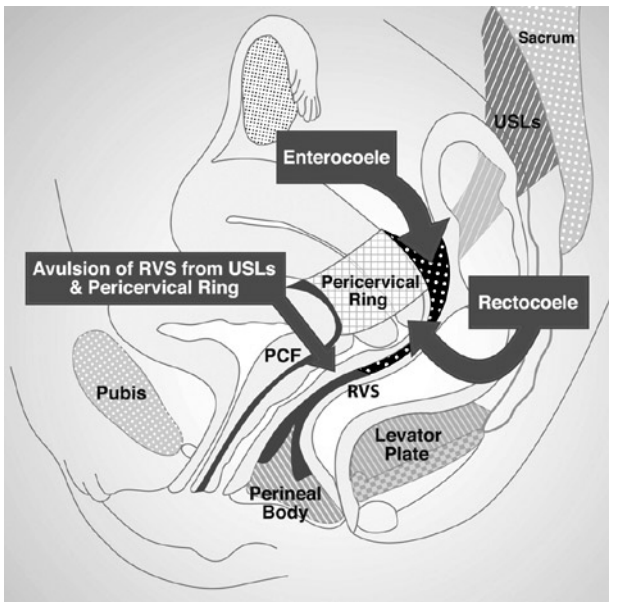


Fig. 2*c*. – This diagram shows the anatomic consequences of damage to the vaginal suspensory axis. Laceration of the uterosacral ligaments above the pericervical ring creates uterine descensus, while avulsion of the rectovaginal septum below the pericervical ring leads to herniation of ileum, sigmoid or rectum into the vaginal lumen.

muscle bundles induce compensatory hypertrophy, making the injured muscle stronger. However, the capacity for muscle hypertrophy is also diminished in older women by catabolism (age or illness related breakdown of the body's proteins) [14, 15] and sarcopaenia (age-related acceleration of myocytes loss via apoptosis).[16] Even so, muscle is a far more robust resource than fascia.

ii) Contractility: Being contractile, the pelvic floor muscles actively oppose intra-abdominal pressure, in two different but crucial ways.

– The *slow twitch fibres* maintain constant postural tone, thus narrowing the urogenital hiatus and elevating the levator plate into a convex, dome-like configuration. The former action directly opposes any tendency for the pelvic viscera to exteriorize, and the latter action creates a dynamic backstop that acts as a flap valve to neutralize passive intra-abdominal forces.

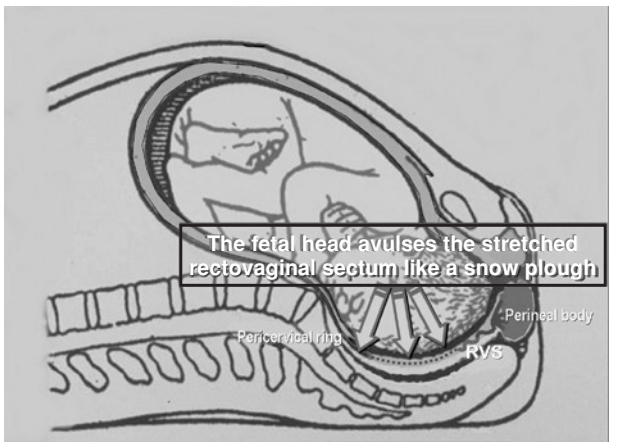


Fig. 3. – Is a diagram from William's Textbook on Obstetrics, showing how the primary fascial injury occurs as the fetal head passes through the mid pelvis. In other words, endopelvic fascia is like canvas - it does not stretch, but will tear at points of extreme stress.

– The *fast twitch fibres* provide rapid reflex contractions which equalise the sudden violent pressure waves generated by coughing or straining, thus preventing Valsalva forces from overwhelming urethral and anal closure pressures.[17-20]

In other words, the physiologic role of the pelvic floor muscles in pelvic organ support is important and irreplaceable.

The role of the endopelvic fascia

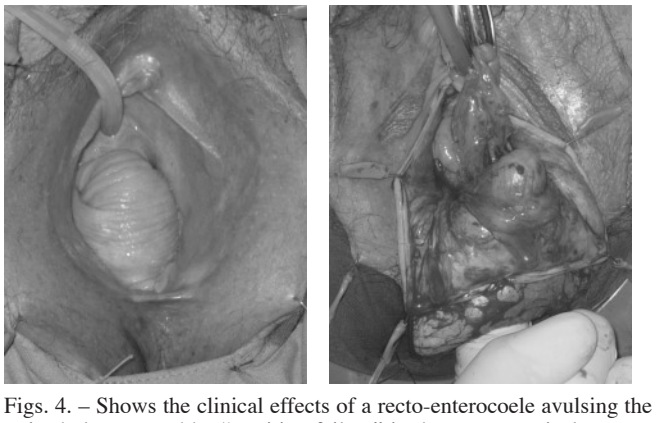
The endopelvic fascia functions more as an investing mesentery, than as a direct visceral suspensory system (such as depicted by Fig. 5*d*).

In this role, it attaches the pelvic organs to the axial skeleton, and thus stabilizes them over the centre of the levator plate. The endopelvic fascia has considerable mechanical strength, and can resist short term expulsive forces. However, any fascial suspension is prone to fail under sustained load, especially if ravaged by age and childbirth damage.

The pathogenesis of prolapse

Pregnancy itself softens the pelvis connective tissue, thus potentially weakening apical supports. However, the key event in recto-enterocoele formation is vaginal delivery, which can cause several complementary patterns of support failure.

a, b



c, d

Figs. 4. – Shows the clinical effects of a recto-enterocoele avulsing the rectovaginal septum below the pericervical ring. 4*a*: The typical posterior bulge, caused by "partition failure" in the postero-apical compartment. Whether the rectocoele or the enterocoele component assumes greater relative prominence is largely a matter of random variation. 4*b*: An assistant's finger in the rectum, highlighting the rectocoele component of the bulge. A "bowel pocket" (causing symptoms of obstructive defaecation) is well demonstrated. 4*c*: A careful dissection on the cranial side of the rectovaginal septum, using Lone Star retractor hooks to aid the dissection. A line of avulsion can be seen between the dense white fascia of the rectovaginal septum (below) and the yellow pre-peritoneal fat of the cul de sac (upper areas). 4*d*: On completing the dissection shown in the previous photo, the cul de sac can be seen to be projecting downwards and forwards as a large enterocoele. The futility of "repairing" this bulge by plicating this pre-peritoneal fat is obvious.

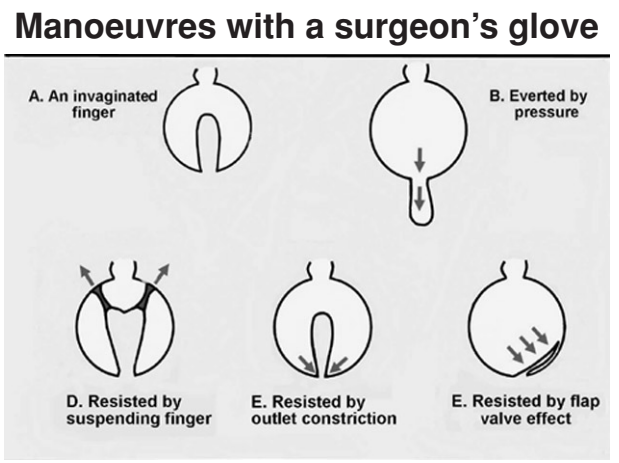


Fig. 5. – The pelvic organ support mechanisms used by Nature are similar to the maneuvers that one would use to prevent an invaginated finger of a surgical glove (A) from being everted under pressure (B). To prevent such eversion, the finger apex could be suspended to the top of the glove by connective tissue (C), the base of the finger could be constricted by postural tone from the pelvic floor muscles (D) or Valsalva forces could be dissipated against the 'flap valve' mechanism of an intact levator plate (E).

– Perhaps the prime insult is a direct avulsion of the pelvic diaphragm from its origin on the levator tendon. Such injuries are seen in about 20% of parous women, and are powerful risk factor for the subsequent of prolapse and incontinence.[21-23]

– Elongation of the nerve to levator ani during descent of the fetal head can also cause a stretch neuropathy and eventual muscle fibre atrophy.[24-27]

– Finally, the endopelvic connective tissue is generally torn by the same obstetric events, creating a group of "site-specific" fascial defects.[12, 28-30]

Avulsive and stretch neuropathy injuries to the pelvic diaphragm result in a sagging concave levator plate and a widened urogenital hiatus (Fig. 6*a* & *b*).

Valsalva pressures are now deflected downwards and outwards, creating a sliding stress on the pelvic viscera. If the fascial mesentery is also torn, the pelvic viscera align over this widened genital hiatus, and are thus susceptible to descensus (Fig. 6*c*).

Childbirth is "an essential but not sufficient factor" in the pathogenesis of prolapse. However, these myofascial injuries are generally compensated for years by the strong connective tissues of young women. Whether or not this series of adverse mechanical events ever results in overt prolapse depends upon the operation of secondary factors, such as nutritional deficiency, repeated abdominal straining, central obesity and the acquired collagen weakness that inevitably develops in a torn anterior or posterior suspensory hammock.

THE HERNIA ANALOGY

Weakened connective tissue adjacent to the 'site-specific' tears has been identified as an important failure mechanism by hernia surgeons. This same phenomenon is probably just as relevant to prolapse repair.

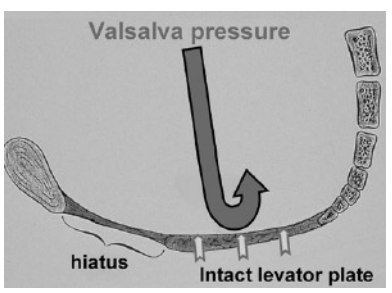
Gynaecologists are beginning to articulate that prolapse is a form of hernia. Let us explore the implications of that assertion in a little more detail.

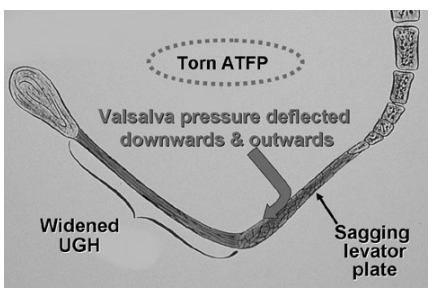
Hernia is the protrusion of an internal organ (usually small bowel) through the muscular wall of the body cavity, generally occurring at a site of congenital weakness. The pathogenesis of hernia has two components.

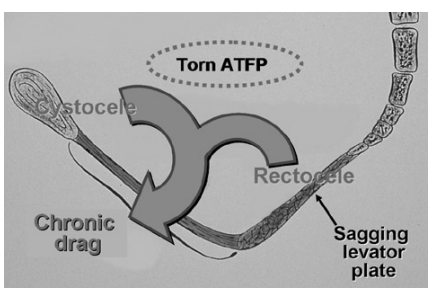
– A *mechanical event:* namely, a 'site-specific' tear in the transversalis fascia at either the groin (inguinal hernia) or the anterior abdominal wall (incisional hernia).

– A *metabolic event:* namely, secondary (acquired) degenerative weakness in the connective tissue of the anterior abdominal wall adjacent to the initial tear.[31-32] This phenomenon is particularly evident in treatment failure patterns for incisional hernia. Firstly, the unsatisfactory results of Mayo duplicative suture repair for incisional hernia have been repeatedly documented, as in a National survey of German hernia surgeons.[33] Analysis has not identified any consistent technique factors that predispose to failure. Secondly, a retrospective, population-based cohort study from a Washington State hospital discharge database (1987-99) demonstrated that the 5-year re-operative rate was 23.8% after the first re-operation, 35.3% after the second, and 38.7% after the third failure. In response to these tissue weakness factors, the use of synthetic mesh in incisional hernia repairs increased from 34.2% in 1987 to 65.5% in 1999. Controlling for age, sex, co-morbidity index, year of the initial procedure, and hospital descriptors, the principal hazard in this population-based cohort study proved to be the use or non-use of a tissue augmentation material (recurrence being 24.1% higher in the 'suture-only' repairs).[34] Thirdly, a multicenter RCT comparing suture versus mesh hernioplasty in 200 patients showed the three-year cumulative recurrence rates to be 80% higher if mesh was not used (43% vs 24%; p = 0.02). Risk factors for recurrence were suture repair, infection, prostatism (in men), and previous surgery for abdominal aortic aneurysm (another disorder known to reflect collagen weakness).[35] Similar reductions

a, b







c

Figs. 6. – A diagram showing the dynamic interaction between the pelvic floor muscles and the endopelvic fascia. 6*a*: The slow twitch fibres maintain constant postural tone, thus narrowing the urogenital hiatus and elevating the levator plate into a convex, dome-like configuration. The former action directly opposes any tendency for the pelvic viscera to exteriorize, and the latter action creates a dynamic backstop that acts as a flap valve to neutralize passive intra-abdominal forces. 6*b*: Loss of postural tone in the pubococcygeus and puborectalis section of levator ani allows the introitus to gape, while loss of postural tone in the iliococcygeus portion would allow the levator plate to sag (thus destroying the flap valve effect). 6*c*: When levator ani weakness is combined with fascial defects, the pelvic organs tend to move forwards and sit over a widened genital hiatus. As such, the combination of muscular and fascial injury has a synergistic effect in predisposing to pelvic organ descensus.

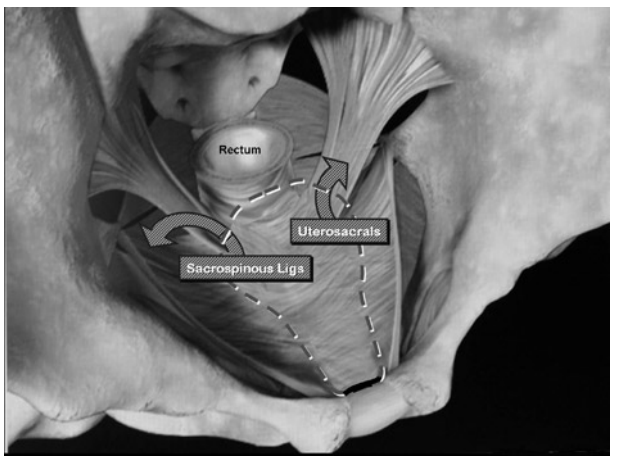


Fig. 7. – Fascia of postero-apical plane, seen in the coronal plane. It takes origin from uterosacral ligaments (centrally) and lower edge of sacrospinous ligaments (laterally), then running down the arcus tendineus fascia pelvis (upper half of vagina), before dipping backwards on the arcus tendineus fascia rectovaginalis, to insert into perineal body.

in inguinal hernias have also been documented in a prospective Denmark-wide study.[36] Finally, the late appearance of incisional hernias several years after laparotomy and the high recurrence rates after 'suture-only' repair (irrespective of surgeon or technique) point to the importance of disordered collagen metabolism in the pathogenesis of both primary and recurrent incisional hernias.[37] This view is supported by the demonstration of a reduced proportion of high tensile strength (type I) collagen and an increased amount of immature (type III) collagen in hernial sacs.[38] Acquired degeneration in collagen quality probably occurs because the 'site-specific' defects in the investing fascia disrupt continuous tissue remodelling, a process that is driven by the transmission of everyday mechanical stress. Such collagen homeostasis is affected by the balance between growth factors and tissue collagenase levels (mainly matrix metalloproteinases-1 and -13).[39, 40] There is a suggestion of disordered MMP-1 and MMP-13 activity in both skin and scars from hernia patients, but evidence to this point has been inconsistent.[41]

Likewise, prolapse is the protrusion of an organ (uterus, bladder or bowel) through the vaginal fibromuscularis, usually at a site of childbirth injury. It also has mechanical and metabolic components.

– The mechanical event is a group of 'site-specific' tears in the endopelvic fascia, as discussed above.

The high prolapse incidence and treatment failure rates in patients with inherited collagen disorders like Ehlers Danlos or benign joint hypermobility syndromes is well known.[42, 43] However, it is also likely that biochemically normal prolapse patients acquire a metabolic collagen weakness in the endopelvic fascia when daily transmission of mechanical forces to the torn suspensory hammocks is disrupted. The argument that tissue weakness is also an important factor in the aetiology of prolapse mirrors that of herniologists. The risk of operative failure rises with each successive reparative attempt, even though subsequent procedures are usually done at tertiary referral centers.[44] Moreover, in a cohort of women with pelvic floor disorders who were followed prospectively for 5 years, a history of prior pelvic prolapse and urinary incontinence surgery was actually a marker for a 42% increase in the likelihood of that patient coming to re-operation.[45] Such failures do not reflect tissue thinning in prolapse women – in fact, the vaginal muscularis layer in enterocoele has been shown to be thicker than normal.[46]

Given that the mechanical of the vaginal wall is likely to reflect composition, thickness and tissue architecture, it is noteworthy that Boreham et al have shown a reduced proportion of physiological smooth muscle and an increased proportion of disorganized smooth muscle bundles with decreased α-actin staining.[47, 48] Prolapse tissue biopsies have been shown to have a decreased collagen concentration,[49] lower collagen I: III ratios, and up to four times higher levels of lytic protease enzymes (as indicated by MMP activity).[50-52]

General surgeons have been able to reduce the failure rate for inguinal hernia from about 35% to ≤2%. The main vehicle of this success has been adherence to a group of rules called the "Hernia Principles". Logic would suggest that the same approach may help gynaecologists to improve their prolapse repair outcomes.

THE HERNIA PRINCIPLES

Over the course of a couple of centuries, surgeons developed a group of cardinal operative rules to reduce hernia recurrence.[53]

These principles are: 1)Avoid wound infection, 2) Protect repair from intra-abdominal pressure, 3) Repair tears in investing fascia, 4) Re-anchor the torn investing fascia back onto skeleton.

The aim is to repair all "site-specific" fascial defects, using permanent suture, and with no tension *in any direction*. However, mobilising the retracted vaginal hammocks back to the mid-pelvis, so many years after childbirth, does inevitably produce a degree of suture line tension.

To these traditional rules, modern surgeons have added the proviso that the most effective way to avoid tension in hernia repair is through the use of mesh. There are two main rules for the prudent use of mesh in hernia surgery:

– The type of mesh (eg weight, stiffness, Amid class [54]) must be appropriate to the intended implantation site

– Surgeons must distinguish between suspensory and bridging functions.

These theoretic principles also fit recto-enterocoele repair – but we cannot directly extrapolate the choice of materials, from hernia to prolapse. The vagina is not the abdomen. Specifically:

– *In the groin*, mesh is implanted through a sterile environment, between two tough & highly collagenized aponeurotic layers, where it lies 5-10 cm deep to body surface. There is minimal tissue-on-tissue movement, and the mesh is well separated from intra-abdominal hollow viscera.

– *In the vagina*, mesh is implanted through a contaminated environment, between a basement membrane and a fragile layer of smooth muscle, just 1/2 cm deep to vaginal mucosa. This is an area of maximal tissue-on-tissue movement. Finally, the implantation site is immediately adjacent to the bladder, ileum and rectum.

Rules have been devised for the tension free placement of mesh:

1) Mesh must suit surgical site, 2) Isolate mesh from contact with a hollow viscus, 3) Limit bacterial colonisation of the mesh, 4) Choice of mesh must suit surgical objectives, 5) Mesh implant must overlap the defect on all sides, 6) Stabilize against doubling, wrinkling & undue shrinkage, 7) Mesh must be placed in a tension-free manner.

ADAPTING HERNIA RULES TO RECTO-ENTEROCOELE REPAIR

Rectocele, enterocele and vault inversion share a common origin - namely, childbirth damage to the endopelvic fascia. Such injuries often occur concomitantly.[11, 12] Gynecologists

have traditionally regarded these three conditions as discrete entities. However, support failure within the anterior and postero-apical compartments are highly correlated.[55, 56] Typically, a patient will present with overt support failure in one segment and incipient weakness in adjacent sites. Paradoxically, despite marked differences in their clinical prominence, both dominant and incipient support defects are of almost equal importance to the reconstructive gynaecologist. That is to say, the fascial supports at the secondary sites may well be strong enough to maintain the *status quo*, but they are often too damaged to resist the new force vectors created when an adjacent vaginal segment is re-suspended. Leaving an area of incipient weakness unrepaired in such circumstances sews the seeds of early failure – often within 6 months or so. In the words of Wayne Baden,[30] the prudent surgeon will always "leave the entire tract intact", or face an unacceptable risk of early postoperative bladder, vault or rectal prolapse.

From a pragmatic perspective, pelvic visceral mesenteries resolve into two semi-independent systems – the anterior and postero-apical compartments. These two systems intersect like a flag and flagpole (Fig. 2*a*). The *anterior hammock* is vital to urinary continence, but has no major supportive role for the vagina as a whole. Conversely, the *vaginal suspensory axis* both suspends the vaginal apex and partitions the vagina from the cul de sac and rectum. When intact, this vaginal suspensory axis forms a membrane that guides faeces efficiently through the pelvis and out the anus. The proximate cause of recto-enterocoele is a 'site specific tear' in the vaginal suspensory axis – creating *suspensory failure* if the injury occurs above the pericervical ring and *partition failure* if damage occurs more distally (Fig. 2*b*).

Effective repair of postero-apical compartment prolapse requires that fascial integrity be restored in two different planes.

– In the *sagittal plane*, fascial continuity must be restored from the sacral periosteum, through the uterosacral ligaments, into the pericervical ring, down the rectovaginal septum and into the perineal body. Historically, this has been most effectively done by threading a narrow ribbon of polypropylene from the sacral promontory to the rectovaginal space (abdominal sacrocolpopexy). However, transvaginal placement of a remodeling biomesh has the potential to deliver even better performance than abdominal sacrocolpopexy, by a cheaper and less invasive technique.

– In the *coronal plane*, restoration of normal anatomy requires that fascial continuity be established from the ischial spines and lower margin of sacrospinous ligament, down the two fascial white lines,[57] to the distally retracted edge of the rectovaginal septum (Fig. 7). Such a repair in the coronal plane cannot be done from above, but is readily accomplished from below.[58]

Such a repair can be done by re-suturing native tissues. However, given that damaged endopelvic connective tissues undergo a slow but relentless deterioration in collagen quality, use of an appropriate tissue augmentation material is more in accordance with modern hernia principles. From a biomechanical perspective, mesh re-enforcement must satisfy two goals:

– *Re-attachment of the vagina onto the uterosacral ligaments (and hence the axial skeleton):* Mesh used for this task must act as a *'suspensory strut'*, for which tensile strength is the dominant consideration. Polypropylene is the strongest available material, but it creates a foreign body reaction and dense avascular scarring.[59] Such inflammatory, non-lubricated fibrosis can be morbid. However, suspensory struts are usually located in static sites (where there is little movement of one tissue on another). Hence, polypropylene has generally been well tolerated, when used as a mid-urethral sling or for sacrocolpopexy. Whether SIS offers any advantage over polypropylene for these operations is presently being debated. It is likely that the wisest choice depends on other patient factors.

– *Closure of any low pressure zone within the postero-apical compartment:* This needs a bridging graft, not a strut. The graft material must be strong but not excessively so. Mesh used for this task must act as a *'bridging graft'*, for which tissue flexibility and a low risk of erosion or pain is more important than extreme tensile strength. In my judgement, polypropylene is a poor choice in this situation. Conversely, SIS performs very well as a bridging graft in almost all patients.[60, 61]

A SMALL CLINICAL SERIES

Effective mesh correction of the posterior defect in two planes requires a roughly diamond-shaped graft. Key points in ensuring a *safe and effective operative technique* were:

– Routine use of the Lone Star Retractor®, to optimize exposure and to create traction / counter-traction throughout the wound. Effective sharp dissection depends heavily on the use of this invaluable surgical tool.

– Pararectal spaces were entered via an essentially bloodless embryologic cleavage plane between the endopelvic and parietal fasciae, allowing easy passage to each sacrospinous ligament.

– A combined bridging and suspensory graft of SurgiSIS® biomesh was secured to the extraperitoneal portions of the uterosacral ligaments (antero-medially) and to the sacrospinous ligaments (postero-laterally). This implant was preshaped, somewhat like a "gingerbread-man" cookie (but with very long "arms" and a short "body") – thus suspending the vagina within the mid-pelvic axis.

In electing to use primarily biological implants, there is one important point must be made about the choice of materials. In the early 1990's, manufacturers "leatherized" various cadaveric and animal grafts, in the hope getting an equally permanent but "more natural" scaffold. Outcome proved to be paradoxical. Although first generation biomesh is strong *in vitro*, reports soon surfaced of an unduly high repair failure rate when Pelvicol®, etc was used *in vivo*.[62] Re-operation often showed no residual graft material. With the wisdom of hindsight, the reason for this phenomenon is obvious. In vivo, any denatured collagen – whether of endogenous or exogenous origin– is seen by the host's immune system as "dead tissue", and hence subjected to an intense biodegradation reaction (ie, encapsulation and enzymatic autolysis). In addition, Pelvicol® provokes a strong foreign body reaction, meaning that the resulting wound can be just as hard and just as stiff as with synthetic mesh. Thus, first generation biologicals with cross-linked collagen are poorly suited for use as a bridging graft, as illustrated a recent rectocoele repair series showing a 41% failure rate at 3 years.[63]

My experience in a pilot study using SurgiSIS® as a bridging graft has been most encouraging.[64-66] At one year follow-up, 46 of 49 patients had outright or qualified anatomic success. There were statistically significant reductions in all pre-operative symptoms, including bulge, drag and defaecatory difficulties. Intraoperative complications were minimal, and no graft-related morbidity or dyspareunia has been seen.[66]

IN SUMMARY

Prolapse repair is associated with stretch dilatation of the anterior rectal wall. However, this is a *secondary* event. The *primary* cause is a combination of pelvic muscle avulsive

and denervation injury, together with various 'site-specific' lacerations of the suspensory hammocks. To be curative, any operation for recto-enterocele must repair the sites of fascial tearing (rather than just plicating the non-specific dilatation of the rectal muscularis).

Surgical options for prolapse repair place more reliance on the endopelvic fascia than occurs in Nature. Attaining a durable repair under these circumstances is a biomechanically difficult task _ even in young women with strong, anabolic tissues. However, this inherently difficult task is much harder by secondary collagen degeneration within adjacent connective tissues. Hernia surgeons have faced and overcome similar obstacles, and it is likely that some of these surgical principles are relevant to gynaecology.

In using tissue augmentation materials, surgeons need to distinguish static struts (where tensile strength is the dominant issue) from *dynamic bridging grafts* (where tissue flexibility and low morbidity are the main considerations). SurgiSIS® is an ideal bridging graft, under almost all circumstances. If properly sized and shaped, it can also perform well as a suspensory strut. However, there are clinical circumstances where the addition of polypropylene is prudent.

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Expert opinion

The future of the Sacral Nerve Stimulation

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Summary: Over the last ten years sacral nerve stimulation has shown great potential in the treatment of pelvic dysfunction. Initially used to treat urinary symptoms it has recently also been used to treat fecal incontinence and constipation. The technique has been refined, by introducing a minimally invasive percutaneous two stage implantation, so that patients can undergo a prolongued test stimulation using a permanent lead. Accurate neurophysiological evaluation can now be performed before, during, and after implantation and this has confirmed improved treatment success rates. Current studies are investigating the efficacy of new treatment systems, based on both direct and indirect sacral root stimulation, and in the future other systems modulating the central control mechanisms and directly stimulating the sacral nerve roots on demand.

Key words: Sacral neurostimulation; Permanent lead; Incontinence; Direct and indirect stimulation; Functional assessment.

RECENT HYSTORY. EVOLUTION OF IMPLANT TECHNIQUE

Sacral Neuromodulation (SNM) is the most innovative treatment modality developed in recent years for the management of pelvi-perineal dysfunction. An intense international scientific debate has been and is taking place, to define indications, rationale, implantation techniques, and long-term results.

In the "Materials and Methods" section of several published studies on SNM the importance of having a test to select patients for treatment is emphasised. The ability to test a patient prior to permanent implantation has characterized SNM from its beginning.

Percutaneous Nerve Evaluation (PNE) enables assessment of response with a temporary lead but these leads have a tendency to displacement due to patient activity, resulting in decreased efficacy because factors such as distance of the lead from the nerve and polarity affect nerve depolarisation.

The original indications for SNM were urinary incontinence and urinary retention. In conditions such as faecal incontinence and constipation the PNE test is unsuitable as a prolongued test is needed to evaluate efficacy. Results of other studies in patients with interstitial cystitis and neurological bladder may also have been inaccurate due to the inadequacy of the PNE test.

Patients with lower urinary tract dysfunction, who have failed to respond to functional electrical stimulation (FES), and for whom reconstructive surgery is too invasive and non-physiological may be suitable for SNM. Patients with a long history of problems who are judged to be suitable for a PNE test but unsuitable for permanent implantation under general anaesthesia may be lost to treatment with SNM.

Psychometric evaluation and Quality of Life assessment has contributed to better patient selection but evaluation techniques still need to be improved.

From the personal experience in performing PNE tests, as well as from a progressively better understanding of the anatomy of the posterior surface of sacrum, acquired by implanting direct extradural stimulators via a sacral laminectomy, the author developed a minimally invasive technique to implant a permanent quadripolar lead. At first this was done with disposable devices used for percutaneous nephrostomy.

In 1999 the author introduced a new technique for positioning the sacral stimulation lead through the S3 sacral foramen under local anaesthesia. This innovation led to the current percutaneous system method in 2001.

A simple method of permanent implantation was devised without any dissection of the tissue planes superficial to the sacral foramen, thus maintaining tissue integrity around the lead.

Between December 1999 and March 2002 forty-three patients had percutaneous implantation of a quadripolar permanent sacral neuromodulation lead. In this technique two 8 Fr. dilators are passed along a guidewire. The first metal dilator is used to pass through the fascial layer, without reaching the sacral foramen, then a plastic dilator is used to pass the lead into the chosen sacral foramen.[1]

All lead implants have been performed using local anaesthetic (Ropivacaine), with fluoroscopic guidance.

Since 2002, two staged percutaneous implantation of a quadripolar lead for electrical stimulation (Model 3889 Medtronic, USA) under local anaesthetic has enabled a extended stimulation test using a permanent lead. This system has dramatically improved the technique, offering a truly minimally invasive approach to implant only one lead.[2]

BEFORE AND AFTER THE IMPLANT: PATIENT SELECTION AND CORRECT PROGRAMMING

In the 90's, in a "pre-neuromodulation era", Clare Fowler[3] claimed the existence of an organic cause for retention, in patients with signs of secondary neuro-endocrinological disturbances. The observation of patients that for many years were in urinary retention, and that after a simple test of sacral roots chronic stimulation regained a spontaneous bladder voiding, led to a major reconsideration of the concept of "idiopathic retention".

In the middle of the 90's, there was enormous enthusiasm for the results of sacral neuromodulation, but poor longterm results in some patients led reseaecrchers to question the indicationsfor treatment with SNM, and raised doubts about the aetiology of this condition.

Variable results with this group of patients have led to renewed efforts to identify predictive factors for success and improving patient selection. Psychometric assessment has enabled identification of patients with a conversion-histrionic disturbance who typically show an excellent immediate result, followed by failure in the short to medium term. Excluding this group has improved the long term results of treatment with SNM.

In sacral neuromodulation , modulating the nervous system of patients referred to as "idiopathic", and of obtaining favourable results in a number of different, and often contradictory, clinical situations is a paradox.

Neurogenic dysfunction is now seen as a complex spectrum of dysfunction with variable expression. Dysfunctions previously thought to be "idiopathic" are now regarded as "non-overt neurogenic". Combinations of symptoms localised to the perineum, such as constipation, urinary retention, sexual dysfunctions, or, the association of urinary and faecal incontinence in the same patient that improve with the same therapy, has led to the realisation that the indication for SNM is localised sacral symptoms.

The sacral area can be regarded as the crossroads of vesical-sphincteric, anorectal, and sexual function. In recent years, the studies of Holstege and Blok have given us an insight into the areas of the brain responsible for control of these functions.

Afferent fibres lead to areas that are referred to as "emotional" in the central nervous system. Neuromodulation of these afferent fibres leads to identification of specific cortical and sub-cortical areas whose expression is modified during SNM. This enables us to postulate the mechanism of action of this treatment.

Clinical issues should be discussed with the patient ethically and honestly. This means informing patients of the true potential and limitations of this therapy as a possible tool to restore the physiological mechanisms of micturition and defecation, rather than as just another treatment option to be offered, after the failure of previous treatments.

The neurophysiological assessment is a new tool to help us predict the response of an individual patient to SNM. It has also been helpful as a research tool in developing a standardised implant technique and defining the best stimulation parameters. Clinical neurophysiology, applied to pelvic floor dysfunction, has progressed both as a diagnostic tool, to improve patient selection, and as a possible tool for a better understanding of the mechanisms of action of sacral stimulation and modulation treatment modalities.

FUTURE PERSPECTIVES

Direct Stimulation

The early history of sacral nerve root stimulation was made with patients with a neurogenic bladder due to a complete spinal injury. The implant of stimulation leads directly on the sacral roots, either intra or extra-dural, was the first technique in humans to evoke a response to a specific electrical stimulation to cause bladder and bowel emptying or an erection in males.

Indirect stimulation

Implanting leads for sacral neuromodulation results in a modulatory effect on control of the sacral area, as shown by neurophysiological and neuroradiological studies. This indirect stimulation is referred to as "neuromodulation".

Based on our experience with both methods, and trying to optimize our results with patients with incomplete spinal injury, since 2003 we have described an original technique for stimulating the pudendal nerve using the same lead used for sacral neuromodulation. The pudendal nerve rises from S2, S3, S4 roots, and its terminal fibers function in the sacral area so Pudendal Nerve Stimulation (PNS) has been proposed for incomplete neurogenic lesions, and for patients who have failed to respond to sacral neuromodulation[4].

The observations carried on the first group of implanted patients have made it possible to recognize two different actions of the pudendal stimulation: a modulatory effect (indirect stimulation), and an acute inhibitory effect (direct stimulation).

This approach is a new minimally invasive option that can show good results when treating all dysfunctions of the sacral area. These results correlate well with the stimulation parameters.

A new era is coming, in which the main goal is to understand which are the best indications for the three modalities available - Direct Nerve stimulation, Sacral Neuromodulation and Pudendal Nerve Stimulation. In the future adjustable stimulation based on the specific dysfunction could replace continuous or on-demand stimulation. Several authors are investigating "intelligent" stimulation, able to monitor, assess and then take action to correct the dysfunction proactively. At present, a number of experimental models exist, but none have yet been realized as an implantable technology.[5]

Currently, investigators are re-evaluating previous implantation sites, with new technologies. For example, in direct sacral root stimulation the aim is to avoid a selective posterior rhizothomy, by providing a stimulation to both anterior and posterior roots, thus ensuring a mixed modulatory and excitatory effect. Similarly the use of appropriate currents should be able to avoid the dissynergic effect deriving from the simultaneous stimulation of all the components (anodal block).[6]

In order to achieve better results in the future a multidisciplinary approach is essential. Recent advances in the use of sacral neuromodulation have shown that a treatment modality can lead to a favourable outcome despite the mechanism of action being poorly understood.

A deeper knowledge of the sacral area from the neurophysiological perspective, the urological and colorectal approach to pelvic dysfunctions, and the introduction of new technologies are all contributing to change our interpretation of pelvic dysfunction from an "anatomic" interpretation to a more "functional" one.

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Original article

Sacral neuromodulation in the treatment of fecal incontinence. The GINS experience.

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SACRAL NEUROMODULATION IS AN OPTION IN THE TREATMENT OF FECAL INCONTINENCE.

Summary: Eighty-eight patients treated and enrolled in the registry of the Italian Sacral Neuromodulation Group (Gruppo Italiano di Neuromodulazione Sacrale - GINS) were evaluated after permanent implantation of a sacral neuromodulation device, with a median follow-up of 12 months. A statistically significant average improvement was observed in Quality of Life (QoL) and General Health Status, according to the Cleveland Clinic Fecal Incontinence Scoring System. Similar results were also observed in the three sub-groups of patients with: idiopathic neuropathy, iatrogenic sphincter dysfunction, and post-rectal resection. Manometric measurements at follow-up were compared with baseline measurements, and did not show a significant difference in total or in the different patient sub-groups. In conclusion, sacral neuromodulation can be regarded as an effective treatment for fecal incontinence in a selected group of patients. Further studies are required to better define the indications for this treatment.

Key words: Sacral neuromodulation; Fecal incontinence; Idiopathic neuropathy; Sphincter lesion; Rectal resection.

INTRODUCTION

Fecal Incontinence (FI) is the inability to control leakage of feces (liquid, solid, flatus) from the anus. The estimated mean prevalence of this condition in the general population is as high as 3.5% in females, and 2.3% in males[1], with a tendency to increase with age. Due to patient embarrassment and reluctance to report FI, these figures probably underestimate its true prevalence[2]. FI is thought to cause significant social consequences for affected people, and to generate high direct and indirect costs, for the individual patient and the total community.

Traumatic anal sphincter lesions, idiopathic sphincter degeneration, spinal cord injuries, and other neurogenic lesions account for the majority of cases of FI in adults. In females, childbirth trauma plays a pivotal role: it is reported that FI can occur in 4-6% of women after a vaginal delivery[3]. A number of patients develop FI from a condition of idiopathic pelvic neuropathy, or from pelvic nerves injury, either of iatrogenic origin, or subsequent to other pelvic dysfunctions. It is believed that all these different clinical conditions might affect the integrity of the anorectal nerve supply, and in particular the sacral nerves which include somatic and autonomic (orthosympathetic and parasympathetic) fibers[4].

Initial treatment of FI is generally conservative, consisting of dietary modification, anti-diarrhoeal drugs, pelvic floor training and biofeedback[5-7]. A number of patients rely only on the use of pads or anal plugs. Different injectable biomaterials have been experimented with in the past, and others are currently under clinical trials, in patients presenting with passive FI, secondary to internal sphincter dysfunction[8, 9]. An overlapping sphincter plasty can be electively performed in cases of external sphincter injury. Although short term results of these procedures show an improvement of FI in 70-80% of operated patients[10, 11], the long term efficacy of this surgical procedure decreases with time[12]. Dynamic gracilo-plasty, or implantation of an artificial anal sphincter may be indicated in cases with wide or multiple sphincteric lesions[13, 14]. The first option offers a significantly higher cure rate, with a lower complication rate. A permanent bowel diversion represents the last option in treatment. It is to be reserved for severe and otherwise intractable cases, or for patients deemed unsuitable for the above-mentioned procedures.

More recently, electrical stimulation of sacral nerves has been used to treat FI, mainly of neurogenic origin, in order to obtain a "modulation" effect on their specific activities, by supplying additional electrical stimulation to both pelvic floor muscles[15], and sensitive neurological pathways[16]. This therapeutic approach is referred to as Sacral Neuromodulation (SNM).

Indications for SNM are still to be clearly defined. Currently an accepted indication is severe FI, with at least one episode per week of leakage of solid or liquid stool after failure of conservative treatment. The largest group of patients in the initial trials demonstrated pelvic floor muscle dysfunction without any evidence of sphincter injury[17]. Recently, other more specific indications for the use of SNM have been identified: FI from idiopathic sphincter degeneration[7, 18], iatrogenic injuries to the internal sphincter[19], incomplete spinal cord lesions[7, 20, 21], scleroderma[22], limited injuries to internal and/or external sphincter[17, 23-25], rectal prolapse[19, 26], and anterior lower rectal resection[27-31]. Patient selection should take into consideration the results of previous conservative treatment, and be based upon the evidence of pre-operative clinical assessment: ano-rectal manometry, endo-anal ultrasound scan, and electrophysiologic studies. Selected patients should undergo a Percutaneous Nerve Evaluation test (PNE Test), in order to assess their response to the SNM. The patient response to a PNE Test is the most significant factor in predicting the therapeutic outcome of a permanent SNM implant.

MATERIALS AND METHODS

SNM Implantation Technique

SNM differs from other surgical options in that the first step, the PNE Test, is a diagnostic tool that also predicts the efficacy of treatment. Permanent implantation of the SNM system should only be performed when there is a significant improvement of FI after a PNE Test.

PNE Test

The PNE Test evaluates the clinical effects of sacral nerve stimulation on anorectal dysfunction at the time of lead implantation. A positive response to the PNE Test shows a positive predictive value for a good long-term re-

sponse to the permanent SNM implant as high as 100%[7, 22, 25, 32, 33].

The temporary lead traditionally used in a PNE Test is monopolar. Developments in implantation techniques allow the PNE Test to be undertaken with the same quadripolar lead that will be left in at the time of permanent implantation. Since sacral nerve stimulation causes contraction of the striated pelvic muscle, and possible changes in pelvic sensation, the PNE Test is best performed under local anaesthesia. After positioning the patient prone on the table, the cutaneous landmarks corresponding to anatomical features of the bony pelvis are identified. The needle-guide is directed to the sacral foramina S2, S3, or S4. The S3 foramen is preferably used, since sacral nerves pass much closer to its ventral aspect. To confirm the correct position of the needle-guide in S3, an electrical stimulation is given and the typical "bellows-like" response should be observed: contraction/relaxation of the external anal sphincter, and of the levator ani complex, plantar bending of the big toe and/or of other toes of the foot ipsilateral to the side of stimulation. A sensitive response is also produced, at the level of the vagina/scrotum, perineum, and perianal area. Confirmation of the correct positioning of the needle-guide is then obtained using fluoroscopy. When a clear and correct response to electrical stimulation is observed, the lead is implanted through the needle-guide, and its position is checked again with both electrical stimulation and fluoroscopy. The implant is then covered with an appropriate dressing, and the lead connected to an external stimulator device, properly set (pulse duration 210 μs, frequency 25 Hz, amplitude: from 1 to 10 V). The minimal duration of the PNE test is 14 days. During the test, the patient is asked to complete a diary where normal episodes of micturition and defecation are reported, as well as any episodes of urinary and/or fecal incontinence. At the end of the PNE test, a QoL questionnaire is administered, and anorectal manometry performed. If a temporary lead was used then it should be removed at the end of the PNE test. Should the patient experience a reduction of at least 50% of fecal incontinence episodes, and a significant improvement in QoL, a definitive SNM device can be implanted. There are cases in which, a double lead implantation can be considered to achieve bilateral sacral nerve stimulation[7, 27, 34].

Permanent Implantation

The Permanent Implantation technique has changed over time. It was initially performed under general anaesthesia, without using muscle relaxants, so the response of the striated muscles to the electrical stimulation could be observed. The needle-guide was inserted in the same foramen previously used for the PNE test. A 10-12 cm long median skin incision was performed in the presacral region and a wide dissection performed to directly expose the sacral foramen. The lead was fixed directly to the sacral periosteum. Further modifications have greatly simplified the lead implantation technique, firstly by reducing the size of the skin incision over the sacral foramen[35] and secondly by developing a percutaneous insertion procedure[36, 37]. Both these steps can be performed under local anaesthesia, simplifying the procedure, and allowing the patient's cooperation in identifying the correct responses to the electrical stimulation. A subcutaneous tunnel is created to seat the lead, and to reach a pouch, which is generally located in the gluteal region, and where the stimulating device is implanted.

The permanent stimulator device is then set to the same stimulation parameters that were identified at the time of the PNE test. These parameters can be subsequently changed, guided by the clinical response, using a remote control.

RESULTS

The Italian Sacral Neuromodulation Group (Gruppo Italiano di Neuromodulazione Scrale – GINS) was constituted in 1996, and now includes 20 Centres in Italy. All data is recorded in a central registry. Prior to December 2005, eighty-eight patients had been treated with a Permanent implant for FI, and registered: 15 males (17%), 73 females (83%); median age 55 ± 12 years, range: 23-81 years of age. The median follow-up after the Permanent implant was 12 months (range: 7-84 months). Five patients (5.7%) required explantation. Indications for SNM were defined in a protocol, which was agreed by all participating Centres. All selected patients were suffering from severe FI (according to the number of weekly episodes of FI, and the Cleveland Clinic Scoring System[38]), and had failed to respond to previous conservative treatments. A thorough clinical assessment was performed, including: anorectal manometry, anorectal electrophysiologic studies, endoanal ultrasound scan, defecatory/urinary diary, Rockwood QoL questionnaire[39], and a health status questionnaire SF-36[40]. Of the 83 patients suitable for a final evaluation, with a still functioning implant, 49 had been implanted for neuropathy (of idiopathic origin in 40, iatrogenic in 9), 19 for a sphincteric dysfunction (iatrogenic in 17, congenital anomalies in 2), 11 patients for FI secondary to rectal resection, 2 for FI secondary to rectal prolapse. In 2 patients the aetiology of the FI remained unknown. The complete set of data, from enrolment in the registry, to the last follow-up was not available for all patients. FI score data were complete in 66 patients, anorectal manometry data was complete in 32 patients, QoL questionnaires were completed by 34 patients, and the SF-36 was completed by 33 patients.

In all the treated patients, SNM caused a significant reduction in the Cleveland Clinic Score, from a median basal score of 15.2, to 6.9 ($p<0.0001$). A similarly significant reduction was observed in those subgroups of patients that were identified according to the aetiology of FI, and where patient numbers were high enough to make a statistical analysis possible. In 33 patients with idiopathic neuropathy, the Cleveland Clinic Score went from basal values of 15.5, to 8.1 at follow-up ($p<0.0001$), in 13 patients with iatrogenic sphincter damage, the Cleveland Clinic Score went from basal values of 19.4, to 5.2 at follow-up ($p<0.0001$), in 8 patients with FI after rectal resection, the Cleveland Clinic Score went from basal values of 16.1, to 5.5 at follow-up ($p<0.0001$).

As far as QoL is concerned, in all the 34 patients assessed with the Rockwood questionnaire, a significant improvement of physical, psychological, and social performance was observed (Table 1). A similar significant improvement was observed in 17 assessable patients with idiopathic neuropathy, as well as in 6 assessable patients with FI after rectal resection. In 8 assessable patients with iatrogenic sphincter damage, the improvement was only statistically significant in the physical and psychological domains (Table 1).

In table 1 are also reported the results of health status evaluation using SF-36. In all the 33 assessable patients, all the explored domains showed a statistically significant improvement, except for physical pain. In the 16 assessable patients with idiopathic neuropathy, significant improvements were evident for physical, mental, social, and general health status domains. In the 8 assessable patients with FI due to iatrogenic damage, a significant improvement was observed in emotional status, whilst less evident improvements were seen in the other domains. The SF-36 evaluation in the 6 assessable patients with FI after rectal resec-

TABLE 1. – *Results of QoL evaluation (Rockwood's questionnaire) and of health status (SF-36), basal and in the follow up (median: 12 months; range: 7-84 months) after Permanent implantation of SNM for FI.*

		Total Cases		*Idiopathic Neuropathy*		*Jatrogenic Sphincter Damage*		*Rectal Resection*	
		basal	FU	basal	FU	basal	FU	basal	FU
	Physical Dominion	2.1a	2.9 a	2.2 b	2.8 b	2.2 d	3.1 d	1.7 f	2.8 f
	Psychological Dominion	1.5 a	2.7 a	1.5 b	2.6 b	1.5 e	2.9 e	1.1 g	2.8 g
	Social Dominion	2.2 a	2.9 a	2.2 c	2.7 c	2.2	3.0	2.1 g	3.0 g
	Physical Function	57.0 h	68.7 h	51.2	62.5	68.8	75.8	56.3 c	78.3 c
	Physical Role	28.9 h	56.7 h	19.6 c	48.2 c	53.1	59.4	5.0 l	85.0 l
	Physical Pain	57.5	65.0	56.7	64.8	52.4	64.6	62.2	77.3
	Health General Status	37.9 i	48.4 i	30.1 c	46.3 c	54.0	53.1	24.5	50.2
	Vitality	41.7 c	53.9 c	35.7	48.3	54.3	62.4	35.0 g	56.7 g
	Social Function	45.1 h	61.7 h	4.0 h	64.1 h	56.3	62.5	33.3 g	62.5 g
	Emotional Role	29.0 b	58.1 b	26.2	38.1	37.5 c	70.8 c	11.1 m	88.9 m
	Mental Health	45.4 e	61.8 e	40.5 g	62.1 g	55.4	58.0	34.0 n	66.7 n

a p<0.0001; b p<0.002; c p<0.02; d p=0.004; e p=0.006; f p=0.009; g p<0.03; h p=0.008; i p<0.04; l p=0.001; m p=0.005; n p<0.06.

tion, showed significant improvements in vitality, physical, social and emotional functions. The anorectal manometry did not show, in all the 32 assessable patients, statistically significant differences between the median basal values and values measured at follow-up. More specifically, the basal tone changed from 60.5 to 71.9 mmHg, the contraction tone from 84.5 to 99.3 mmHg, the threshold sensitivity from 54.3 to 46.5 ml, and the urgency sensitivity from 119.9 to 97.9 ml. In patients with idiopathic neuropathy, the average values have been: basal tone from 61.8 to 69.8 mmHg, contraction tone from 82.7 to 99.7 mmHg, threshold sensitivity from 51.5 to 40.4 ml, urgency sensitivity from 129.7 to 95.6 ml (p=0.022). In patients with iatrogenic sphincteric damage, the manometric recorded values have been: basal tone from 44.0 to 59.0 mmHg, contraction tone from 71.6 to 124.4 mmHg, threshold sensitivity from 63.8 to 65.2 ml, urgency sensitivity from 123.6 to 113.0 ml. In patients with FI after rectal resection, the manometric recorded values have been: basal tone from 77.4 to 82.3 mmHg, contraction tone from 98.0 to 86.8 mmHg, threshold sensitivity from 46.0 to 51.0 ml, urgency sensitivity from 85.0 to 95.0 ml.

DISCUSSION

A decade since it was first introduced, SNM is now a recognised therapeutic option in the management of FI. Despite the good, and sometimes excellent, documented results of this procedure, the mechanisms of action remain poorly understood. In order to define the correct indications for SNM, a systematic analysis of data collected from a population of implanted patients, although heterogeneous, can be helpful. The GINS registry has made this type of evaluation possible. Results of SNM treatment have been changing over time, due to modifications in the implantation technique, and to changes in patient selection criteria. Enrolment in the Registry shows all the limitations that are due to the collection of data from several different Centres, with its resultant variability, although the treatment evaluation tools applied in each individual Centre have all been very similar. Unfortunately, both basal and follow-up data were not available for all the enrolled patients. On the other hand, a major advantage of this kind of evaluation is the opportunity to analyse data from a large series of patients, and to obtain more specific data from subgroups of patients with an adequate sample size.

All the patients treated with SNM reported a significant improvement of their FI, with a reduction in both the daily and weekly frequency of FI episodes. Improvement in FI brought to these patients a positive impact both on QoL and on general health status. More specifically, a significant improvement was observed in all the domains examined in the Rockwood questionnaire (physical, psychological, and social), and in almost all of the domains in the SF-36 questionnaire (physical function and role, physical pain, general health status, vitality, social function, emotional role, mental health). The data from the GINS group are similar to data reported from other Authors of multicentric trials[7, 19, 24, 25, 29, 32, 41-47]. In a recent review, Jarrett[48] reports rates of 41-75% of complete continence to both solid and liquid stools, and reduction greater than 50% in major incontinence episode in 75-100% of patients treated with SNM. A European multicentric trial reported a complete control of FI in 37% of 34 patients treated, with the ability to postpone defecation and with complete evacuation[44]. In our series of 16 patients, SNM restored a full rectal discriminative capacity, and, in the majority of them, the sensation of complete evacuation[49].

Clinical results appear homogeneous, unlike the data from instrumental diagnostic exams, especially manometric data, which is not comparable, and is sometimes contradictory. This is partly due to different examination techniques, but is mainly related to the different aetiology of FI in different groups of patients. These figures are evident also in the GINS experience. Treatment with SNM did not lead to significant changes from the baseline, with regard to anal tone (both resting tone, and contraction tone), and with regard to rectal sensitivity (threshold and urgency). Differences in anal pressures seldom were statistically significant, whereas in other series, variations in rectal sensitivity before and after SNM showed a greater variability. This variability can be explained considering the wide range of differences that may exist in each individual patient (e.g. hyper/normal/hypotonic anal canal, or rectal hyper/normal/hyposensitivity), and that make explain the different manometric findings, although the vast majority of patients share a good clinical response to SNM. If, on one hand, it can be said that these considerations do not help in understanding the SNM's true mechanisms of action, and on the other hand they support the hypothesis that SNM provides a "modulatory effect" on the electrical stimuli directed to the sacral nerves, and from here both to pelvic target organs, and to upper CNS areas. On the base of this hypothetical mechanism of action, it may be possible to treat a number of multifactorial neuromuscular dysfunctions, even though they may be very different from one another.

Nevertheless, in order to better define the indications for SNM, it is mandatory to investigate the effects of this treatment on both specific and homogeneous groups of patients. On the base of data analysis of the GINS Registry, three large enough subgroups of treated patients can be identified, so as to obtain a specific profile of treatment outcome in each group. FI of idiopathic neurogenic origin proved to be the most responsive to SNM. In this study the efficacy of SNM in this sub-group of patients has been confirmed: a significant reduction of the average number of episodes of FI, and of the FI evaluation score, a significant improvement of QoL and of general health status over several domains. There is also a significant reduction in the rectal sensation of urgency in these patients.

The outcomes of patients treated with SNM for FI secondary to iatrogenic sphincter damage, including lesions deriving from vaginal childbirth and from anorectal surgical procedures were very interesting. This sub-group included both patients that have had a previous unsuccessful external sphincter overlapping sphincter-plasty, and patients with an external sphincter lesion, possibly associated also with an internal sphincter lesion, for who SNM was the primary treatment. The effectiveness of SNM in these patients was made evident by the significant reduction in the Cleveland Clinic score, and by the improvement in QoL and health status indices. Also in this group, the manometric findings failed to show statistically significant differences, although the anal contraction tone was increased. Values of rectal sensitivity after SNM appear to be similar to the baseline values. Baseline values are assumed to be normal, since they should not be altered in the sphincter lesion, and this seems to suggest that SNM is acting only on the altered mechanisms, which are responsible for the FI, and not exerting any "modulatory" effect on normally functioning mechanisms.

A new interesting frontier for SNM is in treatment of patients suffering from FI after rectal resection, often performed for rectal cancer. Ultra-low rectal resection with adjuvant radiotherapy and chemo-radiotherapy is becoming more and more frequent in the treatment of these patients. Risk factors for FI include complete ablation or volume reduction of the rectal pouch, possible damage to the internal sphincter due to the use of a mechanical stapler and damage to pelvic nerves, and to sensitive peripheral anorectal structures from radiotherapy. Further damage can occur during surgery: trauma to sympathetic nerve fibers in the para-aortic/caval, superior hypogastric plexus, or hypogastric nerves, to parasympathetic nerves (S2, S3, S4), and to mixed sympathetic/parasympathetic nerves in the inferior hypogastric plexus, and in terminal fibres to the pelvic organs. Treatment with SNM in these patients produced a significant reduction of FI score, and an improvement of both QoL and in the majority of SF-36 domaines, whereas the significance of the manometric data remains uncertain. In these patients SNM is an interesting treatment option.

In conclusion, SNM is an effective treatment option for patients suffering from FI, particularly if of idiopathic neurogenic origin, but also if secondary to other causes. The good results obtained in patients with FI after rectal resection and neoadjuvant radiochemotherapy, and those observed in patients with a continuous internal sphincter lesion, appear to be of particular interest. In all these conditions, SNM had a positive impact on QoL and health general status, while the manometric data is unclear. A better understanding of the intimate mechanisms of action of SNM, thus allowing a better patients selection, can derive from this and from other similar studies.

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Expert opinion

The International Continence Society and Integral Theory Systems for management of the incontinent female. A comparative analysis

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Summary: This work critically examines the recommendations of two rival systems for management of pelvic floor dysfunction, those of the International Continence Society (ICS) and the Integral Theory.
The ICS system, is based on the concept that urodynamics findings are "objective' and therefore "reliable". Unstable bladder symptoms are said to be unreliable, not surgically curable, and require drug therapy. Only patients with "Genuine Stress Incontinence" (GSI) are surgically curable, and patients with "mixed" incontinence, stress and urge, should not be operated on if urodynamics demonstrated "detrusor instability" (DI), now known as "overactive bladder" (OAB). Rather, anticholinergic therapy is prescribed.
The Integral System is a holistic anatomically based system which encompasses all three pelvic organs, bladder, vagina and ano-rectum. It is based on the Integral Theory, a musculoelastic theory which states that connective tissue damage to the 3 zones of the vagina is the ultimate cause of prolapse and dysfunction in these organs. From this theory has evolved a 3 zone diagnostic system, and a minimally invasive surgical system which uses polypropylene tapes to reinforce damaged ligaments or fascia in 3 zones of the vagina. In the context of this theory, DI, or OAB, and all abnormal urodynamic parameters such as low urethral pressure, intrinsic sphincter deficiency (ISD), low flow, residual urine etc. are not separate entities or clinical conditions. Rather than symptoms, they are considered to be mainly secondary manifestations of connective tissue damage.
The Integral System's treatment recommendations differ markedly from those of the International Continence Society, in that symptoms of bladder instability and abnormal emptying in the female are considered for the most part surgically curable.

Key words: Urodynamics; Detrusor instability; Integral theory.

INTRODUCTION

Origins of urodynamics

Bladder pressure measurement commenced more than 100 years ago. In 1933 Denny-Brown[1] measured urethral and bladder pressures simultaneously. He observed spontaneous "all or none contraction" of the bladder, and voluntary muscular control of involuntary micturition initiated by bladder filling. Denny-Brown could explain none of these findings by reference to the smooth muscle anatomy of the bladder.[1] "All or none contraction" of the bladder has been subsequently explained by the work of Creed,[2] who demonstrated muscle to muscle transmission of electrical impulses". Denny-Brown drew no clinical conclusions from his urodynamic studies.

It is generally accepted that the work of Patrick Bates[3] was a key element in the genesis of the ICS urodynamics system. Using combined cini/pressure/flow studies, Bates et al.,[4] objectively demonstrated that many patients who lost urine on coughing also initiated a detrusor contraction, and that coughing could stimulate detrusor contraction per se. Two thirds of patients with recurrent symptoms of incontinence after surgery were found to have unstable bladders. Many patients with unstable bladders operated on preoperatively showed no improvement in symptoms after repair operation. Based on this evidence, Bates and others claimed that the distinction between stress and urge incontinence may be difficult or impossible based on the symptoms and examination alone. For example, a history of leakage on rising from a chair or walking may be particularly difficult to interpret when not associated with urgency. The purpose of urodynamics ('objective') studies was to isolate that group of patients unlikely to respond to surgery who had bladder instability. This viewpoint has been reinforced by many investigators including Stanton et al.,[5] Cardozo et al.[6] However, not all studies reported low surgical success rate with pre-existing detrusor instability. McGuire et al.[7] and Meyhoff et al.[8] demonstrated a high success rate with incontinence surgery in patients with pre-existing detrusor instability, as did Petros in 1997.[9] It is worth noting that Stanton, Cardozo et al performed a Burch colposuspension, which exerts tension on the stretch receptors of bladder base. McGuire performed a bladder neck fascial sling, and Petros a midurethral 'tension-free' sling. These do not greatly tension the bladder base.

The First ICS Report on the Standardisation of Terminology of Lower Urinary Tract Function.[10] This was a major step in pelvic floor science. For the first time, a common language was established. Furthermore, the definitions were stated in such a way as to allow testing for truth or falsity.

All known nomenclature such as frequency, nocturia etc. was defined; also, the methods and interpretations of the emerging science of urodynamics. It was assumed that symptoms were unreliable, but urodynamics was reliable, as it was 'objective', and therefore, scientific. The first definition of detrusor instability (DI) specified a rise in bladder pressure of 15cm H_2O for the diagnosis of 'detrusor instability', subsequently, some definitions were later found to be too limiting. The 15cm limit was removed in 1988,[11] and replaced by a description of an 'unstable pattern'. This replaced the former 'objectivity' with an entirely subjective assessment. The Expert Committee*[11] stated that, be-

* NOTE 1: these 'definitions' and 'recommendations' are but one 'expert committee's opinion. Another 'expert committee' may have given different 'definitions' and 'recommendations'. Despite the inherent fallibility of this process, the ICS 'recommendations' were published as an official document, a rigid scientific declaration, with no allowance for alternatives. Such rigid definitions cannot be reconciled with what was being described, the irregular and unpredictable manifestations of a non-linear biological system, the bladder. The physical principles such as urethral resistance[12 p 176] and connective tissue stretch-extension curves,[12 pp 39, 70] which regulate these manifestations are complex, exponentially derived, and not given to simplification by definition.
NOTE 2: References to specific pages in the textbook "The Female Pelvic Floor", reference,[12] have been made for readers desiring further information.

cause DI was observed in normal women, it was recommended that only patients with urge symptoms could be defined as having "DI". Put another way, urodynamics was required because symptoms were unreliable, and symptoms because urodynamics was unreliable. Unlike the first consultation[10] this recommendation did not allow testing for truth or falsity.

UNEXPECTED CONSEQUENCES OF ICS MANAGEMENT GUIDELINES

Only patients with "genuine stress incontinence" (GSI) were recommended for treatment. Bladder symptoms of urgency were considered unreliable, requiring urodynamics.[11] In patients with both SI and urodynamically diagnosed "detrusor instability" (DI), surgery was said to be contraindicated.

To surgeons who had repeatedly observed clinical cure of urgency symptoms following cystocele repair and incontinence surgery, such 'definitions' and 'recommendations' were contradictory and confusing. Many patients with severe urge incontinence who did not demonstrate an unstable pattern on urodynamics, were told by their physicians that their symptoms were not organic, but psychological in origin. This was an unintended consequence of rigid definitions. Others who sought to follow the ICS recommendations, treated the patient initially with anticholinergics, and performed surgery when the symptoms improved. This was logically invalid, as the drug therapy addressed symptoms, not causation. Anticholinergic drugs, provided temporary relief for some, but were discontinued by most, because of their complications. Even the proscription of surgery in patients with DI (OAB) has been invalidated, Duckworth,[13] Neuman,[14] Petros.[9]

In conclusion only stress incontinence is recognized as being curable by the ICS paradigm. Surgery for urgency, frequency and nocturia is contraindicated, and these symptoms are treated with anticholinergic drugs. No concept exists for surgical treatment of pelvic pain, abnormal emptying or idiopathic fecal incontinence.

THE INTEGRAL SYSTEM

The Integral System has 4 parts.

1. A holistic anatomical theory of normal pelvic organ function,[15, 16, 12, pp 14-33] each component of which, organs, ligaments, muscles, central and peripheral neurological control contributes interactively to normal function, figure 1.

2. A theory of dysfunction which states that symptoms and prolapse are linked, and both are mainly caused by connective tissue damage in the vagina or its suspensory ligaments.[12, pp 34-50] Deriving directly from this is a 3 zone diagnostic system (figures 1, 2, 3).

3. Non-surgical treatment using pelvic muscle exercises which mimic the 3 directional muscle forces.[12, pp 168-172]

4. Minimally invasive surgical treatment (figure 4), for cure of prolapse and abnormal symptoms.[12, pp 83-167] Special instruments apply knitted tapes to damaged pelvic ligaments in 3 zones of the vagina, guided by the diagnostic system (figures 2, 3).

In the context of this theory, 'detrusor instability', or 'overactive bladder' (OAB), and all other abnormal urodynamic parameters such as low urethral pressure, intrinsic sphincter defect (ISD), low flow, residual urine etc. are not separate entities or clinical conditions. Rather like symptoms, they are considered to be mainly secondary manifestations of connective tissue damage.[6, pp. 174-192]

ORIGINS AND DEVELOPMENT

The Integral Theory evolved from the investigation of a series of discordant findings following the prototype intravaginal slingplasty operations performed at Royal Perth Hospital in 1986-9.[15] Patients were cured with xray evidence of no bladder base elevation, an obvious contradiction of the 'Pressure Equalization Theory'. Abdominal ultrasound an dynamic xray studies indicated that urethral closure was activated by a musculo-elastic mechanism.[15]

Bladder instability in the non-neurological patient was defined as a premature activation of the micturition reflex.[17, 18] Urodynamic studies[20] (figure 5), demonstrated the identical sequence of events seen in a normal micturition reflex, first, sensory urgency, then fall in urethral pressure "X", then detrusor contraction "Y", then urine loss. The small arrows denote identical spikes in the bladder and urethra, indicative of repeated fast-twitch contractions of PCM (fig. 1) attempting to close the urethra.

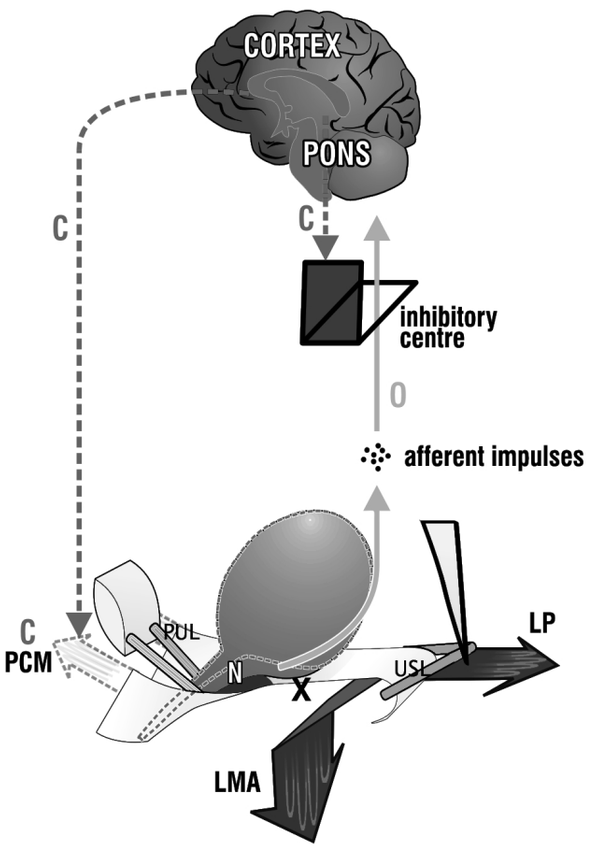

Fig. 1. – Neuro-musculo-elastic bladder control
Bladder in 'open'(micturition) position. The closed phase 'C' is indicated by broken lines and the open phase 'O' by unbroken lines. Micturition Afferent impulses 'O' activate the cascade of events for micturition: relaxation of the PCM and de-activation of the inhibitory centre and closure reflex 'C'. LP/LMA vectors actively open out the posterior urethral wall.
Urethrovesical closure 'C' activates the cascade of events for closure: activation of the inhibitory centres and contraction of PCM to close the urethra from behind. LP/LMA vectors stretch the bladder base backwards/downwards around the pubourethral ligament (PUL) to close the proximal urethra. Note the identical position of LP and LMA in closure and micturition. N = stretch receptors, PCM = pubococcygeus muscle, LMA = longitudinal muscle of the anus, LP = levator plate, X= fascial attachment of bladder base to vagina, USL=uterosacral ligament.

The second (1993) publication of the Integral Theory[16] presented radiological and urodynamic studies and brought a higher level of proof. The 'posterior fornix syndrome' was described (1993 Integral Theory), a symptom complex resulting from laxity in the uterosacral ligaments, "posterior zone" (figure 2). Reconstruction of the posterior ligaments improved symptoms of urge, nocturia, abnormal emptying and pelvic pain.[19, 13] These findings were seminal in the construction of the Pictorial Diagnostic Algorithm (figure 2).

The years 1994 to 2007 have seen a consolidation and international acceptance of many parts of the Integral Theory, in particular, the treatment of stress incontinence with a midurethral sling. The Theory framework has expanded to include fecal incontinence,[12 pp 211-221] abnormal bladder emptying,[12 pp 175-176] and some types of pelvic pain[12 p 73] (figure 2).

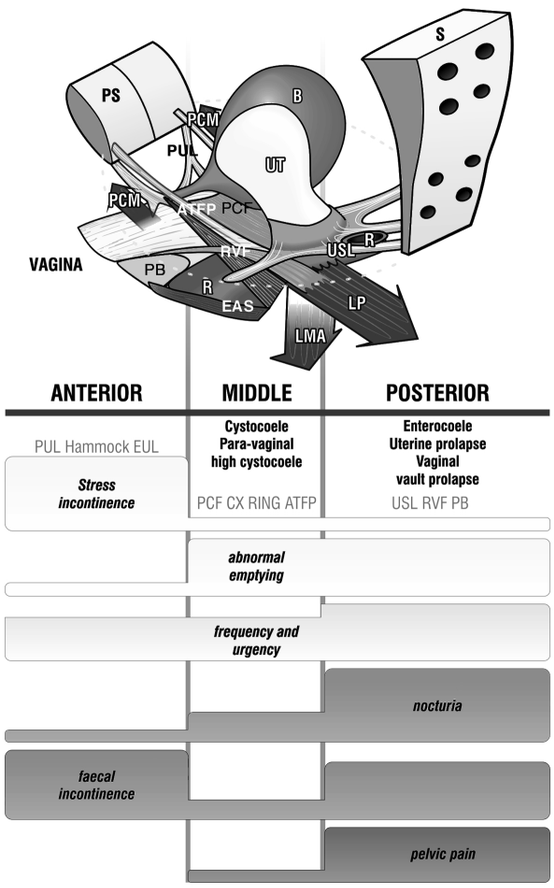

Fig. 2 – The Integral Pictorial Diagnostic Algorithm is designed to be copied and used by the clinician as a record. It summarizes the relationships between structural damage and pelvic floor symptoms in the three zones. The size of the bar gives an approximate indication of the prevalence (probability) of the symptom. The same connective tissue structures in each zone (red lettering) may cause prolapse and abnormal symptoms.
Anterior zone: External urethral meatus to bladder neck.
Middle zone: bladder neck to cervix.
Posterior zone: vaginal apex, posterior vaginal wall and perineal body.
Arrows= directional muscle forces; LP=m.levator plate; LMA= m.longitudinal muscle of the anus; PCM = m.pubococcygeus; PRM=m.puborectalis; PUL =pubourethral ligament; USL=uterosacral ligament; PCF=pubocervical fascia; cx ring = cervical ring; ATFP=arcus tendineus fascia pelvis; EAS = external anal sphincter. R=rectum; RVF=rectovaginal fascia; PB=perineal body.

Validation of these symptoms by more objective data, and by other investigators is slowly emerging, but more proof is required.

With conceptual advances in the bladder's control system, symptoms are the brain's interpretation of the complex interaction between all the different anatomical structures (figure 1). A major problem in attempting to define bladder function, is that all biological control mechanisms are non-linear and often exponentially determined.[19, 6, pp 188-192] This means that every patient is uniquely different, and there are huge variations, even within the same patient. Even a temporary hormonal alteration in an apparently unrelated structure, the uterus, may significantly alter the balance of the whole system, and this may cause significant variation in symptoms. For example, perimenstrual urgency can be explained as follows:[12 p 72] in the days preceding a menstrual period, the cervix softens to facilitate the egress of menstrual blood. This may also cause laxity of the uterosacral ligaments in some women, leading to inability of the muscle forces to stretch the vaginal membrane (figure 6), so that the bladder base stretch receptors fire off prematurely. The

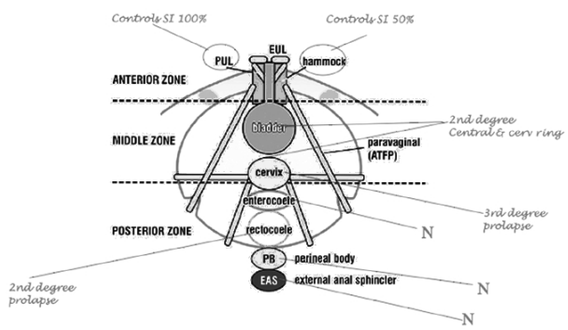

Fig. 3 – The Integral Surgical 3 zone clinical examination sheet is designed to be copied and used by the clinician as a record. Findings in a patient with stress incontinence and prolapse. Each structure is assessed and notated, if possible as 1st, 2nd or 3rd degree prolapse,. PUL, EUL, hammock, PB,, EAS, are designated 'normal' or 'lax'. The % figures in the anterior zone refer to perceived % reduction in urine loss on anchoring each structure sequentially during coughing. Labelling as in figure 2.

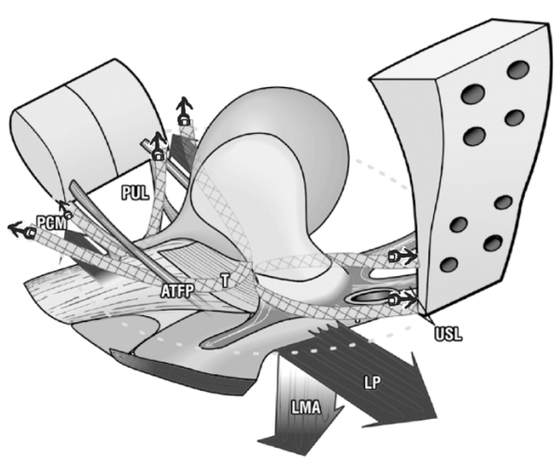

Figure 4 – The Integral Surgical System –a site-specific method for pelvic floor repair.
This is a 3D figure of the pelvis seen from above and behind. Polypropylene mesh slings, in this instance, TFS (Tissue Fixation System), have been applied to correct ligamentous/fascial defects in the 3 zones of the vagina: anterior zone (midurethral sling for stress incontinence), middle zone (central and lateral cystocele) and posterior zone (vault prolapse). Labelling as in figure 2.

brain interprets the afferent nerve impulses as symptoms of urgency, frequency and nocturia.

Suppression of urgency and DI by digital support of bladder base: In patients examined with a full bladder who have urgency, it is possible to temporarily diminish these symptoms with contraction of the pelvic floor, or digital support of the anterior vaginal wall at bladder base, 'simulated operation'[12 63-67] (figure 6). It is even possible sometimes to suppress abnormal urodynamically demonstrated detrusor contractions,[19] either with pelvic floor "squeezing" or digital support (figure 6). These experiments are consistent with the Theory's statement that there may be two important causative components of the unstable bladder in the female: a) capacity for musculoelastic stretching of tissues to provide support for the stretch receptors at bladder base, and b) the sensitivity of the nerve endings 'N' (figure 1). Connective tissue laxity is a key determining factor in the former. Neither a) nor b) can be objectively assessed at the present moment.

The voluntary control of a detrusor contraction mentioned by Denny-Brown is explained by vaginal stretching from an external muculoskeletal mechanism, and the "trampoline analogy" (figure 6).

Further surgical advances: Improvements in surgical methodology[9] have been running on a parallel path with the expansion of the Integral Theory. These new methods were developed because traditional vaginal surgery methods of excision and approximation were unable to restore tissue strength sufficiently to restore structure. To overcome this deficiency, techniques such as the posterior sling, were developed.[12, pp 83-167] Further developments include mesh attachments with suspensory "arms", and more recently, the new tissue fixation system (TFS) The TFS is applied entirely per vaginam as an anterior or posterior sling,[20, 21] for repair of cystocele,[22] rectocele and perineal body.[12, pp 83-167] It provides a new structural method which can entirely replace large mesh. Strips of tape (figure 4), act much like ceiling beams, the vagina being the plasterboard.

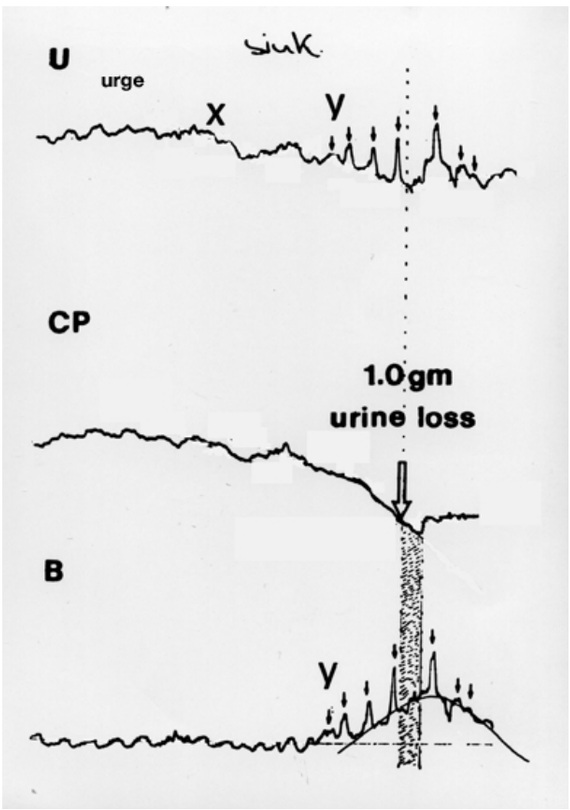

Figure 5 – Urodynamic bladder instability - premature activation of the micturition reflex. Microtransducers in bladder (B) and midurethra (U). CP=closure pressure (U-B).
Note how urgency precedes urethral relaxation (x) which precedes detrusor contraction (y).

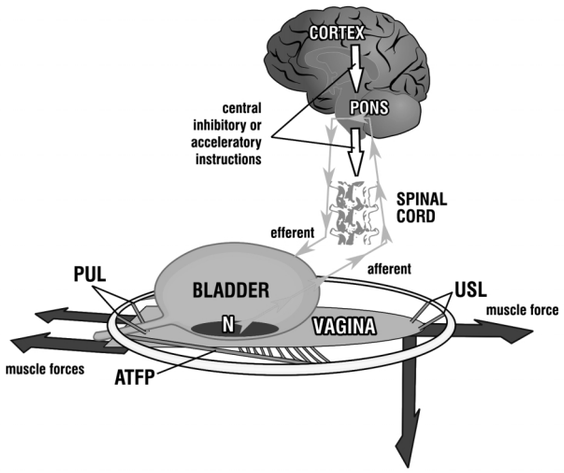

Figure 6 – Peripheral neurological control of micturition – 'trampoline analogy'.
Lax ligaments may unbalance the system to cause urge incontinence. Like a trampoline, the vaginal membrane cannot be stretched by the muscle forces (arrows) to support the stretch receptors 'N'; these fire off at a low bladder volume: 'premature activation of the micurition reflex'. The cortex perceives the afferent impulses as 'urgency' symptoms. Gentle digital support of the anterior vaginal wall at 'N', may suppress urgency by decreasing the afferents to the brain. PUL = pubourethral ligament; USL = uterosacral/cardinal ligament;
ATFP = arcus tendineus fascia pelvis; N = stretch receptors.

CONCLUSIONS

Vaginal prolapse and symptoms (figure 2) are linked, and both can be addressed by surgically reinforcing damaged ligaments with knitted polypropylene tapes in 3 zones of the vagina (figure 4). It is possible to achieve a cure rate up to 80% for stress, urge, frequency, nocturia, abnormal bladder emptying, pelvic pain and idiopathic fecal incontinence after such surgery.

DISCUSSION

There is no conflict between the science of urodynamics and the Integral Theory System. Any perceived conflict the ICS interpretations and 'recommendations' of urodynamic test results disappears if urodynamic readings are interpreted anatomically. Looked at from the perspective of a prematurely activated, but otherwise normal micturition reflex,[18, 19] it is perfectly acceptable for up to 70% of normal women[23] to have evidence of DI ("OAB"). Even the prime reason for performing urodynamics, prediction of surgical failure can be explained by figure 6. Stanton, Cardozo et al in performing Burch colposuspension, needed to stretch the vaginal membrane upwards towards the pelvic brim.[5, 6] This may place undue pressure on the stretch receptors "N", causing neo-urgency. This statement can be directly tested by examining a patient who has urge symptoms with a full bladder. Digitally stretching the vaginal membrane at bladder base upwards and forwards invariably intensifies the urge symptoms. In contrast, McGuire et al.[7] in positioning

a fascial sling carefully at bladder neck, would normally leave a 1cm gap. This methodology would tend to protect against overstretching and neourgency.

Existing urodynamic parameters such as "DI" (detrusor instability) and "CTR" (cough transmission ratio") can be reinterpreted anatomically using "simulated operations":[19, 24] anchoring specific connective tissue structures during urodynamic testing. This maneouvre may temporarily suppress a DI contraction on a graph,[19] or radically change a cough transmission ratio (CTR) reading.[24]

Finite element models: Using computer simulation and fluid dynamic models, Bush, Petros and others from the School of Mechanical Engineering and Fluid Dynamics at the University of Western Australia have identified urethral resistance as a key physical factor in urodynamic pressure measurement.[25, 12 pp 175-176]

Another major physical factor is the biomechanics and neurological control of bladder opening and closure (figure 1). In the future, it is envisaged that this can be reduced to a finite element model (FEM).[26] But first, we will need to measure the strength and elasticity of tissues, sensitivity of stretch receptors, and potential muscle strength. More accurate and more sophisticated ultrasound imaging, urethral and bladder pressure measurement, and more accurate application of the "simulated operation" technique are required. A small beginning has been made in the FEM field by Bush et al.,[25] an on-going development of a computer-based FEM of micturition. Results of work to date may be found on *www.integraltheory.org*.

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Original article

Histo-topographic study of the longitudinal anal muscle

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Abstract: The longitudinal anal muscle (LAM) has been described as a layer of muscular tissue interposed between the external and internal anal sphincters but there is no general agreement in the literature on its attachments and constitution. The aim of the study was to investigate its topography for surgical purposes, with particular reference to its origin, insertion. After in situ formalin fixation, the pelvic viscera were removed from 8 male and 8 female cadavers (age range: 52-72 years). Serial macrosections of the bladder base, lower rectum and pelvic floor complex, cut into horizontal (6 cases) and coronal (6 cases) planes, underwent histological and immunohistochemical study. The remaining 4 specimens were plastinated. The LMA was identified in 10/12 of specimens (83%). In both coronal and transverse sections, it appeared as a layer of muscular tissue. From the anorectal junction it extends along the anal canal, receives fibres from the puborectalis and medial part of the pubococcygeus muscles, and terminates with fibro-elastic septa (7-9) which penetrate the external anal sphincter, reaching the deep part of the dermis. In the transverse plane, the mean thickness of the LAM was 1.63 ± 0.44 mm. Immunohistochemical staining showed that it consists predominantly of striated muscle fibres, with scarce smooth muscle fibres. Due to its attachments, the LMA may play a role in supporting and binding the internal and external sphincter complex together.

Key words: Plastination; Pelvic floor; Incontinence; Longitudinal anal muscle; Sphincters.

INTRODUCTION

The longitudinal anal muscle (LAM) has been described as a layer of muscular tissue interposed between the external anal sphincter (EAS) and internal anal sphincter (IAS) [1] but there is no general agreement in the literature on its attachments and constitution.

Lesshaft [2] stated that the posterior part of the levator ani from the sacrococcygeal column goes down to the posterior part of the perineal portion of the rectum. The external fibres are inserted in the pelvic aponeurosis (tensor fasciae pelvis), and the internal ones inserted in the context of the internal sphincter and the deep part of the anal skin. Cruveilhier in 1852 [3] described that the levator ani contributes with some fibres towards augmenting the outer muscle coat to form the conjoint longitudinal muscle of the anus. Milligan and Morgan in 1934 [4] attributed the contribution to the LAM to the puborectalis posteriorly and the deep EAS anteriorly, whereas Courtney [5] described the LAM as a vertically oriented, striated muscle, which receives contributions from the puborectalis, pubococcygeus and ileococcygeus muscles. Shafik [6] subdivided the LAM into three layers (medial, intermediate, lateral), separated by four fascial septa, which split and decussate below the lower end of the longitudinal muscle to form the "central tendon". In their review, Lunniss and Phillips [7] reported that the LAM composed of a muscular part formed by the fusion of striated muscle fibres from the puboanalis, the innermost part of the puborectalis, with smooth tissue from the longitudinal muscle of the rectum. The layer then becomes completely fibro-elastic and splits into septa, running between bundles of the subcutaneous external sphincter, to terminate in the perianal skin. More recently, Petros (2004) [8] described the contribution to the LAM by the levator ani plate, the lateral part of the pubococcygeus muscle and the puborectalis muscles. The LAM partly surrounds the rectum posteriorly, but is not inserted into it, and runs inferiorly into both deep and superficial EAS.

There is no agreement either on the nomenclature of the LAM, which has also been called rectococcygeus muscle, retractor of the anus of Treitz, tensor fascia pelvis of Kohlrausch, ligamentum suspensorium of Berau, and levator ani proprius of Lesshaft. The LAM is not listed in the last edition of Terminologia Anatomica (FCAT, 1998) [9] and in Gray's Anatomy [1], it is called the conjoint longitudinal coat.

From the functional point of view, Shafik [6] hypothesized that the LAM helps to fix the anal canal to the side wall of the pelvis during defecation, preventing anal prolapse. More recently, the Integral Theory of Petros [8, 10] attributed a key role to the LAM in the closure and opening of the urethra and recto-anal canal.

The aim of the present work is to give a morphological and topographical description of the LAM, for surgical purposes, with particular reference to its origin, insertion, and histological and immunohistochemical characteristics.

MATERIALS AND METHODS

Sampling of the pelvic viscera

The specimens were obtained from 8 male and 8 female cadavers (age range 52-72 years), without a history of pelvic pathology. The pelvic viscera with the surrounding connective tissue and pelvic floor were harvested en bloc from unembalmed cadavers 24 hr after death, according to previously described technique by De Caro,[11] Macchi [12] and Porzionato.[13]

Histology and immunohistochemistry

Twelve adult specimens were prepared for histological and immunohistochemical study. They were fixed in 10% formalin for 15 days, and 5-mm thick slices were cut in transverse and coronal planes with a slicer. The slices were embedded in paraffin and then cut into 10-_m thick sections, which were stained with hematoxylin and eosin (H.E.), azan-Mallory (a.M.), and Weigert's stain for elastic fibers. In the histological sections, the morphology of the muscle was evaluated with particular reference to its shape and its attachments. Morphometric evaluation was carried out with the help of image analysis software (Qwin Leica Imaging System, Cambridge, UK). The following parameters were recorded: on the transverse sections the mean thickness of the IAS, EAS and LAM; on the coronal sections, the mean thickness of the EAS and LAM at the level of their proximal and distal attachments and at a mid-level.

Immunohistochemical evaluation was performed with monoclonal anti-human alpha-smooth muscle actin (mouse IgG2a, kappa, Dako-Smooth muscle actin 1A4, Code No.

M151, 1:50 solution in phosphate-buffered saline (PBS)) and monoclonal anti-rabbit sarcomeric actin (mouse IgM, kappa, Dako-Sarcomeric actin, Alpha-Sr-1, Code No. M874, 1:50 solution in PBS) (Dako A/S, Glostrup, Denmark).[13, 14] The distribution of smooth and/or striated muscle fibers within the LAM was evaluated in the immunostained sections.

Plastination

The remaining 4 adult pelvic blocks were frozen at –20 C° and cut with a slicer into 2-3 mm transverse serial sections. After dehydration in acetone at –25 C° for 2 weeks and degreasing in acetone at room temperature for 1 week, vacuum impregnation was performed with an epoxy resin E12 mixture (BiodurTM Products, Heidelberg, Germany). After vacuum impregnation, the specimens were cured by exposure to ultraviolet light and heat (50 C°).[11, 13, 15-18]

RESULTS

In coronal sections, stained with H.E. and azan-Mallory (a.M.), the LAM was identifiable in 5/6 of specimens (83%). It appeared as a layer of muscular tissue interposed between the IAS and EAS. It was recognisable at the recto-anal junction; at a *more anterior level*, it extends along the anal canal (Fig. 1), receives fibres from the puborectalis muscle (Fig. 2), and terminates with 7-9 fibro-elastic septa (Fig. 3) which penetrate the EAS, reaching the deep part of the dermis. The muscle fibres show a predominantly vertical course and no fibres directed from the LAM to the IAS are recognisable. At a *more posterior level*, the LAM receives fibres from the medial part of the pubococcygeus muscle, and gives rise to fibrous septa along its course and at its distal end. Some of these septa run towards the separation between the deep and superficial parts of the EAS. Other very thin septa run through the IAS, reaching the submucosal plane. The muscular fibres show a predominantly oblique course. The mean thickness was 2.09 ± 0.32 mm at the origin, 1.38 ± 0.38 mm at the middle level, 1.23 ± 0.05 mm at the distal attachment.. At its proximal attachment, the LMA seems in continuity with the longitudinal muscle of the rectum. In all the cases, Weigert's staining showed the presence of elastic fibres in the distal attachments of the LAM.

In the transverse sections, the LAM showed a circular configuration, interposed between IAS and EAS. The mean thickness of the LAM was 1.63± 0.44 mm, of the IAS 2.69 ± 0.53 mm, and of the EAS 2.95 ± 0.89 mm. The fibres showed prevalent transverse (4/6) and oblique (2/6) courses. In 5/6 cases, the fibres were more densely packed on the anterior side.

Immunohistochemical staining showed that the muscle consisted predominantly of striated muscle fibers, with a few smooth muscle fibres.

In the transverse plastinated specimens, the LAM was located between EAS and IAS, and recognizable on the lateral and posterior aspects of the anal canal; the muscle bundles of the LAM were directed postero-anteriorly.

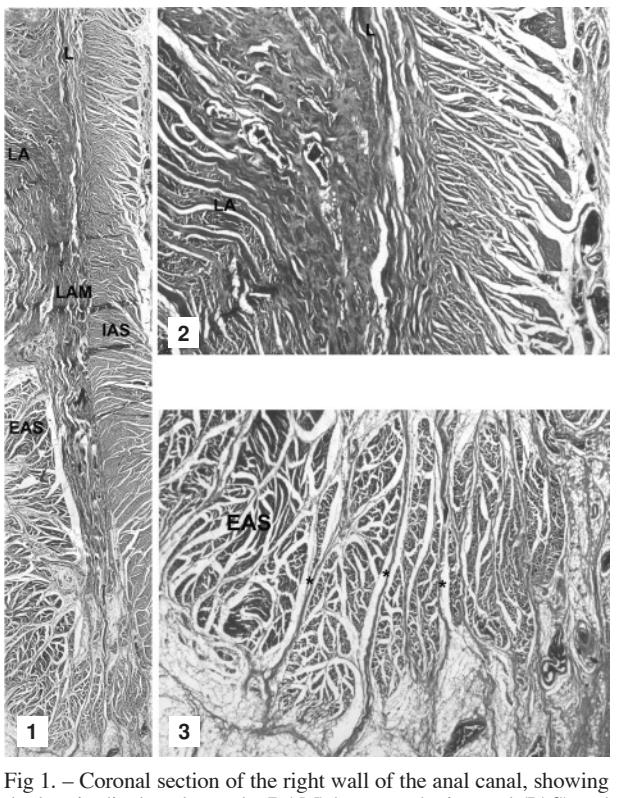

Fig 1. – Coronal section of the right wall of the anal canal, showing the longitudinal anal muscle (LAM) between the internal (IAS) and external anal sphincter (IAS). L, longitudinal muscle of the rectum.
Fig. 2. – Magnification of the upper part of fig 1 showing the contribution of the levator ani (LA) to the LAM.
Fig. 3. – Magnification of the lower part of fig. 1 showing the LAM that terminates with fibroelastic septa (asterisks). (azan Mallory staining, original magnification X 2.5).

DISCUSSION

A review of the literature concerning the anatomy of the LAM revealed little uniformity in description of the origin and contribution by surrounding muscles and in the medial, outward and inferior extensions.[7] Nevertheless, a functional role has been suggested for the LAM in the dynamics of pelvic floor function and dysfunction.

From the surgical point of view, knowledge of the topography of the LAM is important when developing minimally invasive solutions for patients with faecal incontinence. Surgical treatment is indicated according to the severity of the condition. Many surgical options for both urinary and faecal incontinence have been developed in the last two decades, but the surgical community continues to search for simple, inexpensive and minimally invasive solutions. Many techniques to treat urinary incontinence have been adapted and applied to faecal incontinence: artificial sphincters, neuromodulation of the sacral nerves, and bulking agents.[19-21] The adaptation of these techniques require a detailed knowledge of the topographical relations between EAS, IAS and LAM. Our study confirms the intersphincteric location of the LAM, interposed between IAS and EAS, with mean thicknesses of 1.63 mm (LAM), 2.69 mm (IAS), and 2.95 mm (EAS). These data partially fit those of Gerdes et al.,[22] who reported a mean thickness of the LAM of 2.85 mm and of the EAS of 3.62 at the level of the dentate line. These differences may be ascribed to different fixation and level of section.

The different appearance of the LAM in the coronal section at anterior or posterior levels may explain the differing descriptions in the literature. In fact, as regards the extension of the muscle, our study shows that its appearance is quite different from anterior to posterior levels. In the anterior level, 7-9 fibro-elastic septa are predominantly located at the distal end and penetrate the EAS, reaching the deep aspect of the dermis. This description fit that of Shafik,[6] who described 6 fascial septa in relation to the different parts of the muscles of the anal canal, which run downwards, and then split, and decussate at their termination, to form the central tendon from which multiple septal prolongations in different directions arise. On the posterior plane, the LAM gives rise to fibrous septa along its course and at its distal end. Some of these septa run towards the boundary between

the deep and superficial parts of the EAS. Other very thin septa run though the IAS, reaching the submucosal plane. This description is in accordance with those of Abel [23] and Milligan and Morgan.[4] The former reported that the LAM passes between the superficial and deep parts of the EAS and around the sphincter. The latter described two septa, one constant, passing between the superficial and subcutaneous components of the EAS, and one inconstant, between the deep superficial parts.

As regards muscle characteristics, the LAM is described as being a direct continuation of the outer muscle coat of the rectum, receiving contributions from the surrounding pelvic muscles. Cruveilhier [3] reported contributions from the levator ani, Milligan and Morgan [4] from the puborectalis posteriorly and the deep EAS anteriorly, Courtney [5] from the puborectalis, pubococcygeus and ileococcygeus, Shafik [6] from the pubococcygeus, and Petros [8] from the lateral part of the pubococcygeus and puborectalis. Our study shows that the LAM receives fibres from the medial part of the pubococcygeus and puborectalis muscles, and that it consisted predominantly of striated muscle fibers, with a few smooth muscle fibres, probably deriving from the longitudinal muscle of the rectum. It is interesting to note that the smooth fibres are located sparcely in the context of the muscle, whereas Shafik [6] smooth muscle fibres located predominantly in the inner part of the, named medial longitudinal muscle, representing the prolongation of the longitudinal muscle coat of the rectum. It may be hypothesised that the fibres deriving from the levator ani, with those deriving from the longitudinal muscle of the anus, and that the fibres from the pubococcygeus and puborectalis run obliquely, also reaching the inner aspect of the LAM. However, the contribution of the levator ani prevales over that of the longitudinal muscle of the rectum, also determining a close link between the LAM are subdivided in three layers: upper, middle and lower. The middle layer corresponds to the LAM, described as a striated muscle not attached to the rectum, which connects the upper and lower muscle layers.[8] The LAM, with its vertical course, creates a downward force for bladder neck closure during effort and stretches the outflow tract open during micturition. A similar mechanism has also been proposed for the ano-rectal function, in which the LAM angulates the tip of the levator ani downwards, creating the ano-rectal angle.[8] Shafik [6] also attributed to the LAM a role in defecation, during which the rectum and the pubococcygeus contract, with consequent contraction of the LAM. Due to its attachments, contraction of the LAM shortens and widens the anal canal, the direction of contraction being upward and lateral because of the longitudinal extension of the pubococcygeus muscle. The anal and perianal skin is everted, and the anal orifice is opened. Shafik suggests calling the LAM the “evertor ani muscle”. Since in the present study we documented the double contribution to the LAM from the levator ani, wider action of the LAM may be suggested. Due to its characteristic attachment, in the first phase the fixed point may be represented by the inferior, fibro-elastic attachment of the LAM: when the latter contracts, there is a downward force, with shortening and widening of the diameter of the anal canal, which becomes more linear. In the second phase, the fixed point is represented by the upper portion: contraction of the puborectal sling and consequently of the LMA creates an upward force and restoration of the ano-rectal angle of continence.

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Review

Functional urological complications after colo-rectal cancer surgery

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Abstract: Surgery for colo-rectal cancer is a common procedure, and it is associated with a high incidence of functional urological complications. These complications are due to damage to the pelvic nerves during mobilization of the rectum. In particular the sympatic and parasympatic innervation of the low urinary tract can be disrupted, both in male and female patients. The urological functional damage requires a correct diagnostic workout peri and post-operative and an adequate treatment strategy, in order to avoid permanent impairment. A nerve-sparing surgical approach to the rectum could minimize the entity of damage to the pelvic nerves. This technique is difficult, due the complex anatomy of the neural branches. The patient, not only the surgeon and the urologist, should be aware of the possibility of functional complications after rectal surgery, and informed upfront that such complications can be successfully prevented, monitored and treated

Key words: Rectal cancer; Rectal surgery; Neurological damage; Functional complications.

INTRODUCTION

Colo-rectal cancer is a common disease. The Incidence is estimated as 15.7 (male) and 10.4 (female population) / 100.000. The number of patients undergoing curative colorectal surgery has increased, due to the introduction of new surgical strategies, such as total excision of the mesorectum (TME), and confirmation that short surgical resection margins are acceptable.[1]

Surgical options for patients with cancer of the lower third of the rectum include anterior resection with anastomosis (AR), and abdomino-perineal resection (APR). Both procedures have a significant impact on the patients' quality of life, the stoma itself for obvious reasons, but also the presence of a low anastomosis, which can disrupt the normal rectal function. Urological dysfunction can also result from low rectal surgery. Urological dysfunction detected immediately after surgery requires correct diagnosis and appropriate treatment in order to avoid permanent impairment. The incidence of low urinary tract symptoms after colorectal surgery is between 20 and 40%, higher in male patients (M:F = 4:1) due to anatomical differences or the presence of benign prostate enlargement, which increase the possibility of neurological dysfunction in men. On the other hand, multiparous female patients can present with significant pelvic floor damage. Nevertheless, postoperative symptoms are often transient and usually only 10% of patients require medical or surgical treatment.

The aim of this study is to assess the incidence and magnitude of urological functional damage, in particular regarding the lower urinary tract, following surgery for rectal cancer. To this purpose, we reviewed the international literature available on this subject.

We searched the Medline for English language papers relating to human studies with no time limits based on the following search keywords: rectal neoplasm, rectal neoplasia, rectal adenocarcinoma, rectal cancer, colo-rectal cancer, urological dysfunction, functional urological dysfunction, voiding dysfunction, bladder dysfunction and low urinary tract symptoms.

BACKGROUND

Urinary dysfunction is a well-known complication of colo-rectal surgery. Increased understanding of the anatomical and physiological background and improved surgical techniques have lead to a reduction of complication rates.[2] As an example, utilizing the TME technique, the rectum is mobilized with a fine dissection along the pelvic fascia.[3] This technique was described by Enker[4] as a method of preservation of the autonomic plexus, in order to minimize urinary and sexual dysfunction. Recent studies confirm that the TME technique leads to a significant reduction in adverse side effects.[5] The use of different surgical techniques have also reduced the incidence of functional damage. In the late 80s the TME proposed by Headl et all[6] was introduced into surgical practice. It consisted of rectal dissection with total meso-rectal excision under direct vision. TME has soon become a widely utilized procedure, due to its success in curing the cancer combined with a better functional outcome. In contrast, the technique, utilized in the 70s, of extended rectal dissection was associated with severe urinary and sexual dysfunction, due to damage to the autonomic pelvic nerve plexus.[7] More recently, extended research into the anatomy and physiology of the pelvic nerves has provided extensive data and information, allowing a detailed mapping of the macroscopic neuro-anatomy of the pelvis.[8] Nevertheless, one possible negative aspect is the individual anatomical variability and morphological abnormalities of the pelvis, which can increase the challenge of correct intraoperative identification of the nerves. Finally, oncological extension of the disease and direct infiltration of the pelvic plexus can require the dissection of the nerves along with the tumour, potentially resulting in severe functional damage.

AUTONOMOUS PELVIC PLEXUS: ANATOMY AND PHYSIOLOGY

A layer of soft connective tissue, the mesorectum, which contains blood and lymphatic vessels and the rectal lymphnodes, surrounds the rectum. In its posterior part, a thin fascia, the visceral fascia, covers the mesorectum. The pelvic part, which is located posteriorly to the rectum and its own fascia, is covered by an additional thin fascia, called the parietal fascia. The visceral and the parietal fascia identify a space, the retro rectal space, filled by connective tissue. Resection of this tissue allows access to the retro rectal space and mobilization of the rectum. Both sympatic and parasympatic nerves constitute the pelvic nervous plexus. Sympatic roots originate from L2 and L3. They form first the aortic plexus (or superior hypo gastric plexus), and then the hypo gastric plexus below the parietal peritoneum at the level of the aortic bifurcation. Distal to the sacral pro-

montory these fibres form the hypo gastric nerves, which run lateral to the ureter and the internal iliac artery, joining the pelvic autonomic plexus at the lateral pelvic wall. The parasympatic fibres originate from S3-S4 in the male, and from S2-S4 in the female and run along the erigentes nerves, which cross the sacral foramen and reach the pelvis and the inferior hyponastic plexus. This plexus is located anteriorly and laterally to the rectum, deep below the peritoneum, over the endopelvic fascia, which covers the levator anii muscle. The autonomic pelvic plexus, known also as inferior hypogastric plexus, is constituted by nervous tissue localized in the pelvic wall, in close proximity to the prostate and the seminal vesicles in the male. In the female, it is localized anteriorly and laterally to the rectum, running by the cervix and the vaginal fornix, and reaching the lateral vaginal wall and the bladder base. The main part of the plexus is localized at the level of the vaginal fornix. The autonomic sacral plexus is constituted by fibres coming from the hypo gastric nerve and from the sacral splancnic nerves, and gives origin to fibres for the genito-urinary organs and the rectum. The parasympatic fibres are involved in the erection mechanism, increasing the blood flow in the penis or in the vulva and vagina, and enhancing vaginal lubrication and erection of the clitoris and the labia. These fibres contribute also to the innervation of the detrusor muscle, and are therefore involved in the micturition mechanism. On the other hand, the sympatic fibres are related to ejaculation and to the rhythmic contraction of the genitals during orgasm, in the male and most probably also in the female. Moreover, the sympathetic fibres inhibit the detrusor muscle, and stimulate the contraction of the bladder neck, taking part, as a result, in the continence mechanism.[9, 10, 11, 12]

URINARY FUNCTION

The current rate of urinary dysfunction after surgery for rectal cancer is between 30 and 70%. Several factors, besides preservation of nerve fibres, are involved in the pathophysiology of mild urinary incontinence.[13, 14] Loss of sympatic innervation due to damage of the hypo gastric nerve, may be responsible, in the female, of urgency and/or stress incontinence. A number of studies published in the 70s and 80s have shown a high rate of *de novo* low urinary tract symptoms (8-70%), after abdominoperineal resection.[15, 16, 17, 18, 19]

Urodynamic characteristics of denervation damage have been reported in some recent studies, and identified as reduction of bladder compliance, detrusor hypo contractility, and reduced competence of the bladder neck.[20, 21, 22] Bladder dysfunction is a common complication of pelvic surgery. Functional urinary problems arise in 24-32% of patients after surgery for rectal cancer (Tab. 1). Damage to the visceral sacral nerves can lead to detrusor denervation and decreased bladder sensitivity. As a consequence, the patient may experience voiding dysfunction, overflow incontinence, and loss of bladder filling sensation. Additionally, the posterior bending of the bladder, which can occur during abdominoperineal resection, could lead to voiding dysfunction. Lower urinary tract infections can result from incomplete bladder emptying. Sympathetic denervation due to damage to the nerves of the hypo gastric plexus, can result in urgency and stress incontinence, or detrusor hyper reflexia, which can lead to a severe degree of bladder contraction. In some cases, these symptoms are present even before rectal surgery, as a result of patient age, chronic inflammation or other common clinical conditions including benign prostate enlargement and prostate cancer. Finally, damage to the pudendal nerves, even if not common after anterior rectal resection, can result in a reduction of bladder sensitivity and erectile dysfunction. Finally, it should be noted, that clinical symptoms of pelvic nerve damage could be mixed and not necessarily linked to damage of a specific neurological compartment. The resulting clinical effects are most often multiple, with different prevalence of one compartment over the others in different cases.

TABLE 1

Author	*Year*	*Patients n.*	*Female*	*Bladder dysfunction (%)*	*Erection dysfunction (%)*
Havenga [23]	1996	138	39	32	17
Maas [24]	1998	47	30	28	11
Maurer [25]	1999	60	36	24	24
Sterk [26]	2005	52	30	24,8	27

CONCLUSIONS

Bladder dysfunction is common after pelvic surgery, especially after surgery for rectal cancer. During dissection of the mesorectum, the rectum is mobilized, with possible damage to the sympatic and parasympatic nerves, which travel to the bladder and are involved in bladder function. It has been shown that surgical damage to the nerves of the hypo gastric plexus, the pelvic plexus and the cavernous nerves can also lead to low urinary tract dysfunction. The clinical manifestations can vary, according to location and extent of surgical damage. Permanent lesions can be observed following complete transection of the main nerves, while transient dysfunction can occur following traction of the main nerves or transection of the peripheral branches. There is a direct correlation between the clinical symptoms and the exact nature of the neurological damage produced, even thought currently it is not possible to localise the site of the damage based on the clinical symptoms.

A nerve-sparing surgical approach to the rectum could minimize damage to the pelvic nerves. This technique is however difficult, due the complex anatomy of the various neural branches.

Three areas can be identified as “high-risk” areas for neural damage: one in the abdomen and two in the pelvis. In the abdomen, the risk is linked to the ligation of the inferior mesenteric artery, which can result in damage to the hypo gastric plexus. At the level of the pelvis on the other hand, a critical surgical step is mobilization of the rectum posteriorly. Damage to the nerves erigentes is possible. These nerves run in proximity to the visceral fascia of the rectum. The lateral dissection can endanger the pelvic plexus, both at the sympathetic and parasympathetic level. Finally, the anterior mobilization of the rectum can result in damage to the cavernous nerves where the anterior rectal wall is separated from the prostate and the seminal vesicles only by the Denonvilliers fascia.

Deeper knowledge of the potentiality of neural damage during rectal surgery has contributed to the development of nerve–sparing techniques, such as the autonomic nerve preservation techniques (ANP). Several studies have shown that TME with ANP results in a reduced incidence of urinary dysfunction, compared to conventional surgery.

In conclusion, urinary complications after rectal surgery are becoming less frequent and are more often transient, due to a better understanding of the anatomy and physiology of the pelvic nerves, increased attention to the functional outcomes of oncological surgery, improved diagnostic tools and increased efficacy of pelvic floor rehabilitation programs. The patient, not only the colorectal surgeon and the urologist, should be aware of the possibility of functio-

nal complications, and informed prior to surgery that such complications can be successfully prevented, monitored and treated or that they may spontaneously revert back to normal with improvement of symptoms and a return to the pre-operative situation.

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Case report

Can motor urge incontinence be surgically cured?

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Summary: Urodynamic testing confirmed that surgical restoration of vault prolapse can cure motor urge incontinence as hypothesized by the Integral Theory.

Key words: Urgency; Motor urge incontinence; Integral theory; Posterior intravaginal sling.

INTRODUCTION

Though symptomatic cure of urge incontinence has been previously reported by reinforcing the uterosacral ligaments, no urodynamic evidence of this has been presented to date. The following case is presented. A 60 year old teacher with a history of severe motor urge incontinence had been treated unsuccessfully with drugs over many years. She was very depressed. On straining, the posterior vaginal wall was prolapsed to within 1cm of the introitus. There was no urine loss on cough. Invariably she wet the floor on the way to the toilet. During fast-fill cystometry (100mls/minute) a massive painful detrusor contraction was noted at 180 mls volume, the patients maximal bladder capacity. The patient underwent Posterior Vaginal Slingplasty for repair of her vault prolapse. The day after surgery, she voided volumes of 300-500 mls spontaneously and was entirely dry. Three months later urodynamic testing demonstrated a maximal bladder capacity of 350 mls without urine loss at any stage, and with no evidence of detrusor instability.

CASE REPORT

A 60 years old teacher, presented with a 5 year history of urinary frequency every 15 minutes, nocturia 4-5 times per night, severe motor urge incontinence, difficulty with defecation, and "dragging" lower abdominal pain which varied in intensity. She had no stress incontinence. She had undergone abdominal hysterectomy because of fibroids 8 years earlier, and a laparotomy for a benign ovarian tumour 4 years after the hysterectomy. She delivered 3 infants vaginally, two of which weighed more than 4000 gm. She had consulted several urologists and gynecologists, and had been investigated on several occasions with ultrasound, urodynamics and cystoscopy. She was treated with pelvic floor exercises and several anticholinergic-type drugs without success. From a social impact perspective, she was unable to finish a lesson without several visits to the toilet. She was constantly embarrassed by the urine odour from her pads to the point where she had ceased sexual intercourse, holidays, and all social contact. When first seen, she was very depressed and under psychiatric care because of suicidal thoughts.

She was assessed according to the structured questionnaire and examination[1, 2]. On the way to the examination couch, she developed an uncontrolled urge and wet the floor. On speculum examination, she had a chronic vulvovaginitis due to irritation from the chronic urine loss. The vagina was only 5cm long. The anterior vaginal wall was anatomically normal. The posterior vaginal fornix and the posterior vaginal wall were prolapsed and bulging 2cm beyond the introitus on straining (Fig. 1). There was no urine loss on cough stress testing and the 24 hour pad test yielded 255 gm of urine loss. The 24 hour diary confirmed her history of a urinary frequency 30-40 per day. On palpation, the muscle tone of the levator ani was reduced. Ultrasound confirmed normal urethrovesical anatomy and function during coughing and straining, with a normal anterior and posterior shelf, and absence of any cystocele.

Urodynamic testing (Fig. 2) demonstrated a first desire to void at 100 mls, (detrusor pressure 3cm H_2O). At 160 ml the patient experienced a strong desire to void (detrusor pressure 11 cm H_2O). At 180 ml volume the patient developed a massive painful detrusor contraction (detrusor pressure 50 cm H_2O) which resulted in a large urine loss. Maximal urethral closure pressure was 154 cm at rest and 150 cm during coughing, with no urine leakage.

The patient underwent a Posterior Intravaginal Slingplasty (infracoccygeal sacropexy) procedure with rectovaginal fascia and perineal body repair. The catheter was removed 12 hours post-operatively. The patient voided spontaneously, volumes of 300-500 mls. There was immediate cure of all symptoms that continued over the ensuing 4 years of follow-up. Frequency was reduced to 4-5 per day; nocturia, 0-1 per night; pelvic pain was 100% cured; defecation was normal; urge and urge incontinence were cured and the patient was 100% dry.

A structured assessment was performed post-operatively at 3 months. The questionnaire confirmed symptomatic cure. From a social impact perspective, the patient had resumed going to the theatre. She was able to teach without any visits to the toilet, and to travel on bus and plane. There was normal restoration of anatomy on vaginal examination. The vaginal length was now 7cm, with a normal axis and angle. The 24 hour pad test gave a zero gm urine loss.

Urodynamic testing (Fig. 3) demonstrated a first desire to void at 220 mls (detrusor pressure 15cm H_2O) and a second desire to void at 290 mls. Maximal bladder capacity was

Fig. 1. – Entero/rectocele grade 2-3.

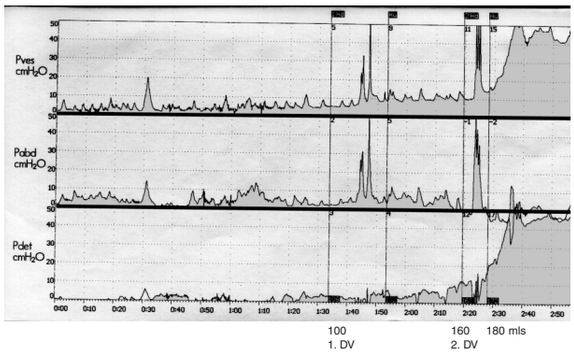

Fig. 2. – Urodynamic testing pre-operatively.

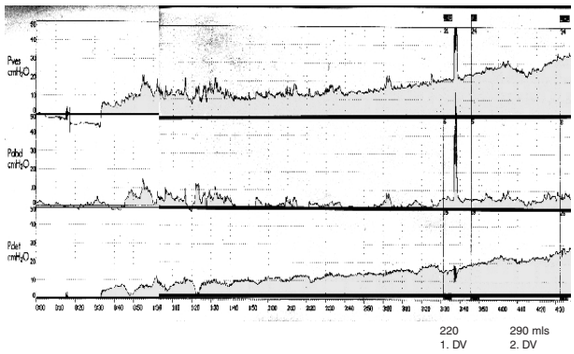

Fig. 3. – Urodynamic testing 3 month post-operatively.

350 mls (detrusor pressure 29cm H_2O). There was no urine loss at any stage.

This patient presented with an everting vaginal vault prolapse, and the classical symptoms of the 'posterior fornix syndrome" as described by Petros and Ulmsten in 1993[1]. The surgical cure of urge incontinence, frequency and nocturia is controversial. The aim of this operation was primarily to cure the vault prolapse. However, it also presented a unique opportunity to challenge the underlying Integral Theory of Petros & Ulmsten. The symptoms comprising this syndrome include frequency, urgency, nocturia, some types of pelvic pain, and abnormal bladder emptying. Farnsworth[3] reported cure of such symptoms with the Posterior IVS operation for repair of uterovaginal prolapse in 80% of cases following restoration of the 3 levels of anatomy.[4] However, there has not been any objective proof offered to date in any of the previous studies to confirm the basis for cure hypothesized by the Integral Theory. The post-operative urodynamic findings, figure 2, appear to confirm that anatomical restoration of the posterior ligamentous supports of the vagina may not only cure the vault prolapse, but also improve the symptoms of the "posterior fornix syndrome".[1]

Sixty years earlier Heinrich Martius[6] mentioned already in his textbook of gynecology that symptoms of urgency, frequency, nocturia and pelvic pain were potentially curable by restoration of vaginal anatomy, but Petros and Ulmsten[5] have given the anatomical basis for cure of these symptoms: in essence, the vagina is suspended anteriorly by the pubourethral ligaments, posteriorly by the uterosacral ligaments and in the middle by the pubocervical fascia and the arcus tendineus fascia pelvis ligaments. Three muscle forces stretch the vaginal membrane like a trampoline to support the bladder base stretch receptors. If the membrane is loose, the stretch receptors may fire off prematurely at a low bladder volume to stimulate the micturition reflex. This is interpreted by the cortex as frequency, urgency and nocturia. The reason for the pelvic pain is said to be due to inability of the uteroscaral ligaments to support the unmyelinated nerve fibres running along the ligaments: gravity pulls the lax ligaments downwards and this stimulates excessive afferent pain impulses from the unmyelinated nerve endings travelling to the cerebrospinal nerve system.

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