A comparison of native vaginal and ligament surgery for cure of pelvic organ prolapse and overactive bladder

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Abstract: The key messages from the Shkarupa *et al.* native cardinal/uterosacral ligament (CL/USL) study, was that, in premenopausal women, ligament repair alone is sufficient for cure of pelvic organ prolapse (POP) and urgency, achieving cure rates of 85.7% for POP and 81.6% for urgency at 12 months. However, in postmenopausal women, the cure rates were 20.5% for POP and 33.3% for urge at 12 months. The *Lancet* Prospect Trial recorded 21% for native vaginal repair at 12 months. The poor POP cure rate in the Prospect Trial, and the rapid deterioration in the post-menopausal CL/USL repair group, can be explained by known biomechanics. The vagina has little structural strength. Ligaments, with a much higher breaking strain, are the main structural support of pelvic organs. Yet, even native ligament repair reported very low cure rates at 12 months. The poor results in postmenopausal women with native ligament repair can be explained by collagen breakdown after the menopause, as collagen is the key structural component of ligaments. An important question posed in the ligament repair study was, "What happens to women cured by ligament repair after the menopause when the collagen leaches out of the ligaments?". One recommendation was that collagen creating tapes be routinely applied in prolapse surgery and OAB, at least in postmenopausal women. The recommendation for routine collagen-creating ligament repair methods, especially in older women, are supported by high 5-year surgical cure rates in 70-year-old Japanese women, 91.2% for POP, at 12 months, falling to 79.0 at 60 months, using collagen creating Tissue Fixation System (TFS) minislings.

Keywords: Postmenopausal; premenopausal; collagen; native tissue; ligament repair

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Introduction

The key points of the article are summarized in the video abstract (Video S1).

"*Ligaments are for structure*, *vagina for function*". Integral Theory (1).

The incidence of pelvic organ prolapse (POP) and overactive bladder (OAB) (frequency, urge, nocturia) is increasing, parallel with the ageing of the population, more especially in Japan (2). Worldwide, about 40% of women will experience POP, and this proportion is expected to increase with the aging of the population (3). As regards

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surgery, in 2008, the lifetime risk for an 80-year-old woman undergoing at least one POP surgery in Denmark was 18.7% (4). Traditionally, native anterior and posterior repair of the vagina have been applied to repair prolapse, but cure rates remain dismally low. In contrast, high cure rates for POP and OAB (urge frequency nocturia) have been reported using collagen-creating sling (5) techniques to repair the uterosacral ligaments (USLs) (6-12), analogous to midurethral sling (MUS) surgery.

However, more recently, these posterior sling operations have been placed in the same category as mesh sheets. They are banned by regulatory bodies in many western countries, and in some, the MUS also. In such countries, native tissue repair remained the only available option for women who have prolapse.

Results from studies

We compare native vaginal tissue repair (12), native ligament (13) and site-specific ligament repair with collagen-producing mesh tapes (10,14).

Native vaginal repair

In 2017, the *Lancet* Prospect Trial assessed 430 women mean age 59 years, who had mainly standard vaginal repair for "POP" (12); 78 had co-occurring urinary incontinence (12). The failure rate for native tissue vaginal repair of the prolapse 6 months after surgery was 79% (12).

Native cardinal/uterosacral ligament (CL/USL) repair

In 2021, Shkarupa *et al.* studied the effect of native tissue CL/USL repair on POP and "OAB" (frequency, urgency, nocturia) and POP (*Table 1*) (13). An important inclusion criterion was decrease of urge symptoms following insertion of a roll gauze tampon in the posterior fornix of the vagina ("simulated operation") (13). The importance of this preoperative test was that it linked the urge symptom to the USLs. Exclusion criteria were stress urinary incontinence (SUI), and POP grades 3–4. The surgery consisted of plication of cardinal and USLs.

Prolapse was assessed by the Baden-Walker classification, and OAB by the Urinary Distress Inventory Short Form 6 (UDI-6), Overactive Bladder Questionnaire (OAB-q), Pelvic Floor Impact Questionnaire-Short Form 7 (PFIQ-7), and International Consultation on Incontinence Questionnaire-

Table 1 Cure rate of POP and overactive bladder symptoms in different points of follow-up (13)

POP/OAB symptoms	Pre-menopausal group (n=49) (%)	Post-menopausal group (n=39) (%)
3 months		
Frequency	71.5	64.1
Urgency	85.7	82
Nocturia	96	64.1
POP	98	89.7
6 months		
Frequency	77.5	48.7
Urgency	85.7	64.1
Nocturia	98	59
POP	85.7	48.7
12 months		
Frequency	63.3	38.5
Urgency	81.6	33.3
Nocturia	71.5	25.6
POP	85.7	20.5
18 months		
Frequency	59.2	15.4
Urgency	67.3	17.9
Nocturia	87.7	20.5
POP	79.6	15.4

Reused from (13). Copyright 2021, with permission from *Central European Journal of Urology*. POP, pelvic organ prolapse; OAB, overactive bladder.

Highlight box

Key findings

- Native ligament surgery gives good cure rates for pelvic organ prolapse (POP) and overactive bladder (OAB) pre-menopausally, but low cure rates post-menopausally.

What is known and what is new?

- Vaginal surgery has poor results for POP repair.
- Ligament surgery gives good cure rates for OAB and POP, but only in premenopausal women, not postmenopausal women.

What is the implication, and what should change now?

- In postmenopausal women, collagen-creating methods are needed to structurally reinforce weakened ligaments for POP repair.

Urinary Incontinence Short Form (ICIQ-SF) questionnaires and voiding diary. Postoperative assessment was performed at 3, 6, 12 and 18 months after surgery. There was a marked difference between the premenopausal and postmenopausal women for POP, and all the OAB symptoms, urge, frequency, nocturia (*Table 1*) (13).

Ligament repair alone was sufficient for cure of POP and urgency in premenopausal women, achieving cure rates of 85.7% for POP and 81.6% for urgency at 12 months. For postmenopausal women, at 12 months, the cure rate for POP was 20% and for urge 33% (*Table 1*) (13).

With reference to the excellent results for premenopausal women at 18 months (*Table 1*), the authors (13) raised the questions, "What happens after the menopause? Would collagen breakdown cause POP and OAB?" (13). Their recommendation to use collagen creating tapes for women with significant prolapse and OAB, was based on their unit's experience (6). More comprehensive details are available in Shkarupa *et al.*'s paper (13).

POP repair using collagen-creating slings

A dramatic difference between native ligament repair and collagen-creating slings in post-menopausal women was demonstrated by long-term data from Japan; Inoue *et al.*'s 5-year data for POP and lower urinary tract symptoms (LUTS) (12) in 70-year-old Japanese women was: 91.2% for POP, 96.8% for urge at 12 months, falling to 79.0% for POP and 91.7% for urge at 60 months (11). Further validation was provided by this group's 10-year data, 960 women with 3,100 implants (10).

Ligaments are the main structural support of the pelvic organs, while the vagina's principal role is to transmit the pelvic muscle forces which open and close the urethra and prevent premature bladder emptying (urge incontinence) (1). Native CL/USL ligament repairs work well for premenopausal women, but not for postmenopausal women (12,13). The experience of many authors (7-13) and, in particular, the 10-year experience of Inoue *et al.*, 3,100 tape implants in 960 70-year-old women with 3rd and 4th degree POP with no vaginal excision, indicates that collagen creation methods will be required for good POP surgery results, at least in postmenopausal women (10). Hand-cut artisan tapes can be used with individual patients where commercial kits are banned (14). An emerging technique, plication of ligaments with wide-bore polyester sutures (15), already shows great promise. If longer-term results are satisfactory, it could become an available low-cost solution for countries where all mesh products are banned for vaginal surgery. This method has already been applied to repair pubourethral ligaments for SUI (15), cardinal and USLs for prolapse and OAB symptoms, and also, deep transversus perinei ligaments for cure of descending perineal syndrome and urge fecal incontinence, as described elsewhere in this special series.

Discussion

Hitherto, the relationship between age and higher incidence of OAB and POP after the menopause was known but was never clearly defined. Shkarupa *et al.*'s trial (*Table 1*) very clearly delineated that the menopause is a defining point as regards prospects for surgical cure for both POP and OAB symptoms, and, therefore, the decision for surgery (13).

A very important part of Shkarupa *et al.*'s study (13) was the direct linking of USL weakness and urge by only operating on women who were screened by a preoperative test: reduction of urge by placement of a roll gauze in the vaginal fornix to mechanically support USLs. Cure of OAB by CL/USL repair provides the first experimental evidence of a direct link between USL laxity and OAB (13).

One important difference between the *Lancet* Prospect vaginal repair Trial (12) and the ligament repair trial (13), was the different strengths of the tissues which were repaired: ligaments have a breaking strain 300 mg/mm^2 and the vagina, 60 mg/mm^2 (16). Shkarupa *et al.* repaired the CL/USL with no vaginal excision. Ligaments are the structural components of the pelvic floor, while the vagina is concerned with function, transmitting the muscle forces which open and close the urethra (1). The structural collagen 1 in ligaments is much stronger than the collagen 3 and elastin of the vagina which provide its elasticity.

We can deduce from basic biomechanical principles, that, in order to preserve its elastic function, the vagina should be conserved, not excised. Furthermore, collagen deficient ligaments in the menopause need new collagen to be created, so as to prevent the USL ligament elongation which results in organ prolapse and even anterior rectal wall intussusception (*Figure 1*), and to retain their structural function. It is evident on inspecting *Figure 1*, that the organs are suspended by ligaments. Excising and suturing the vagina, a weak structure, cannot by itself cure either a cystocele, or a uterine prolapse, as proven by the *Lancet* Prospect Trial (12). Notwithstanding adherence to these surgical principles (13), the poor results in the menopausal group (*Table 1*), can be reasonably explained by

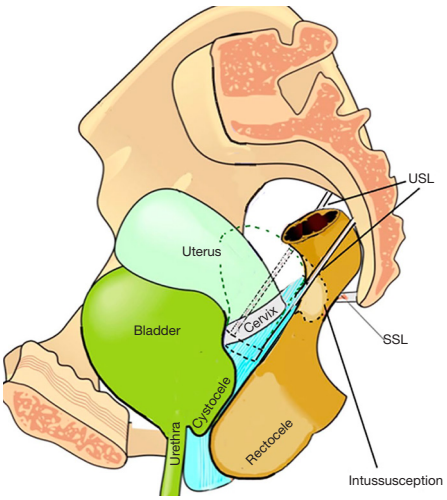

Figure 1 Anatomy of uterine prolapse, cystocele, rectal intussusception, rectocele. The cardinal ligament (not shown) is attached to the anterior part of the cervix; the anterior vaginal wall is attached to the cardinal ligament and the cervix. The uterus is suspended by "USL" which if stretched or damaged, elongate to cause uterine prolapse. The rectal intussusception is a consequence of the lateral USL attachment to the rectum pulling down the anterior rectal wall so it invaginates into the rectal cavity. An overstretched or torn perineal body posteriorly allows ingress of the rectum into the vagina as a rectocele. Reused from Petros P. The female pelvic floor function, dysfunction and management according to the Integral Theory. 3rd ed. Heidelberg: Springer Berlin; 2010. With permission from Peter Petros; retains ownership of the copyright. USL, uterosacral ligament; SSL, sacrospinous ligament.

collagen breakdown after the menopause and excretion as hydroxyproline throughout the menopausal period (17).

Conclusions

The key message from Shkarupa *et al.*'s CL/USL study was that in premenopausal women, ligament repair alone provides good cure rates for POP, and urgency at 12 months. However, catastrophically low cure rates were noted for both conditions in post-menopausal women. Shkarupa *et al.* advised that post-menopausal women required collagen-creating slings. These comments were validated by Inoue *et al.* Using the collagen-creating Tissue Fixation System (TFS) minisling, high 5- and 10-year surgical results for POP and urge were reported in 70-year-old Japanese women (2,11). The final question by Shkarupa *et al.* was "What happens to the successful POP and urge group results after the menopause?". However, this raises another significant question, "Should collagen-creating methods be used routinely for women with POP and LUTS?".

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