



# Surgical reconstruction for apical vaginal prolapse

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## ABSTRACT

Given that surgical reconstruction for apical vaginal prolapse demands proper training and involve hazards to the pelvic organs, is a challenging issue for pelvic floor surgeons. Patients suffering advance uterine prolapse presents with a variety of debilitating symptoms and significantly impaired quality of life. Proper understanding the herniation nature of the problem and precise pelvic floor anatomy details are essential for being able to design and perform a safe, curative and durable pelvic floor reconstruction. Patients having post hysterectomy vaginal vault prolapse are in a worth situation, as the anatomy is frequently distorted, the supportive tissues are weakened, and the vagina is often shortened. All these makes the efficient reconstruction even more difficult; the following summary was written to shed light on this particular field.

**Keywords:** Apical vaginal prolapse; gynecology; surgical reconstruction

## INTRODUCTION

### Post Hysterectomy Vaginal Vault Prolapse (PHVVP) Backgrounds

The accurate occurrence of PHVVP is obscure. It is presumed that the reported rate reflects barley the iceberg tip. Pelvic organ prolapse (POP), entailing many sub groups as vaginal wall relaxation, uterine prolapse, PHVVP and others, occurs with up to 50% of parous women. It was reported to cause a variety of urinary, bowel and sexual symptoms and to necessitate surgical correction in 11% of the female population. Up to 30% of all females suffer from pelvic floor relaxation progressed to a level which has a negative impact upon their quality of life (QoL). The affected women frequently require manual assistance to urinate

and report frequency, urgency and urge incontinence as well as sex and bowel function-related symptoms. The lifetime risk of undergoing prolapse surgery is one in eleven, whereas up to 30% of those who underwent surgery eventually will have repeat prolapse surgery, part of them after hysterectomy. Being age-related, it is assumed that the prevalence of POP will further increase with the ageing of the population. Hysterectomy results probably with damages to the integrity and blood supply of the endo-pelvic fascia as well as to the innervation of the pelvic floor musculature. This might potentially contribute to later POP manifestation. As data regarding the causative roll of hysterectomy with POP occurrence is missing, there is a considerable debate whether vaginal hysterectomy is improving or negatively affecting the efficacy the surgical reconstruction

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of the POP, thus is essential or contra-indicated for long lasting repair. The natural history of post hysterectomy pelvic floor status was never looked at properly to determine whether should the prolapsed uterus should be removed or preserved in terms of POP cure. Similarly, were not the peri-operative complications and general QoL improvement, including the impact of hysterectomy on the female body image and sexuality looked at properly with vaginal hysterectomy in comparison with preservation of the prolapsed uterus or uterine cervix. Nevertheless, PHVVP challenges commonly the healthcare practitioner, requiring thorough understanding of the pathology and adequate skills for treating it.<sup>1-3</sup>

### Vaginal Apex Support Natural Architecture

Based on cadaver dissections, reported were three pelvic levels of support: The first relates to the upper vagina, found to be suspended with paravaginal tissue fibers, connected to the cardinal ligaments. The second one supports the mid vagina by fibers connecting it to the arcus tendineus fascia pelvis and the levator muscles. The lower vaginal part is supported with the perineal membrane and the perineal body. These vaginal supporting fibers and ligaments are actually condensations of the endo-pelvic fascia, forming anterior support: The cervico-pubic ligaments, lateral support: The cardinal ligaments and posterior support: The sacro-uterine ligaments. The endo-pelvic fascia attaches the supportive pelvic floor musculature, mainly the levator muscles to the vagina, assembling the supportive effect. The pelvic floor plate consisted of the endo-pelvic fascia and musculature (mainly the levator muscles) forms a supportive trampoline. This pelvic floor anatomical specific unit is ligamentarily stretched both on the antero-posterior and lateral dimensions. Thus, caring the pelvic organs, it enables their proper function.<sup>4,5</sup>

### PHVVP Definition

Prolapse is defined as protrusion of an organ or structure beyond the normal anatomical position. Mild prolapse is very common and is generally not associated with QoL impairment, thus it is regarded as a non-pathologic situation. PHVVP, according with Baden classification is defined as: 1<sup>st</sup> degree: The vaginal vault is slightly descended from the natural level, 2<sup>nd</sup> degree: The vaginal vault is visible at the introitus, 3<sup>rd</sup> degree (procidentia): The vaginal vault is protruded out of the introitus, at any extension. Prolapse of the apical segment of the vagina was redefined by the International Continence Society Standardization Committee, on 2002 to be: “any descent of the vaginal cuff scar (after hysterectomy), below a point which is 2 cm or more less than the total vaginal length above the plane of the hymen”, and the prolapse degree is defined according

with the ICS Pelvic Organ Prolapse Quantification System (POPQ). According with the POPQ is the normal position of the vaginal apex (C point) level measured 8 cm. above the genital opening, hence defined as (-)8. Total vaginal vault prolapse is measured as 8 cm. below the genital opening, defined as (+)8. The vaginal vault prolapse might be isolated or combined with prolapse of the anterior vaginal wall and anterior pelvic floor compartment, including bladder prolapse (cystocele) and/or urethral prolapse (urethrocele) at various degrees. Smilingly might be the posterior vaginal wall and the posterior compartment of the pelvic floor be affected by the supportive defect and enterocele, rectocele and/or perineal body damage can be associated with the apical prolapse.<sup>6</sup>

### PHVVP Incidence

POP is very common, and to some degree normal, especially among older women. Over all POP may occur in up to 50% of parous women. It is reported to significantly impair QoL and necessitate surgical correction in 11% of the female population. Up to 30% of those who underwent surgery will have repeat prolapse surgery for failure within 3 years. The accurate incidence of over all vaginal apex supportive defect and particular PHVVP was not properly evaluated yet. It is probably correct to assume that hysterectomy, vaginal rather than abdominal, aggravates the risk for further vaginal prolapse. This might be due to surgical damage as well as to un-addressed pre-existing weakness of the pelvic floor. The estimated incidence of PHVVP, yet it is widely accepted that the reported rate reflects only the iceberg tip of the problem.<sup>7-9</sup>

### PHVVP Risk Factors

Pelvic floor relaxation and POP is related to some well-established risk factors. Among those are parity, obstetrical pelvic floor trauma, obesity, tobacco smoking, aging, chronic bronchial asthma and constipation. All these are regarded as related to increasing with intra abdominal pressure. Then, extra strain is applied to the supportive structure and pelvic nerves, yielding further damage and eventually prolepses at various degrees. Another risk factor is lately identified-the tissue factor. The tissue inherited strength is gaining recognition as a crucially important one, mainly the tissue collagen content and structure. Patient having a bio-molecular alternation with the collagen amount, architecture, bio-degradability or production might be subject to POP during life. This condition might be rising out of a genetically inherited predisposition. PHVVP could be related to surgical factors, as failure to suspend the vaginal apex to the sacro-uterine ligaments or further suture break down, both leading to vaginal prolapse.<sup>10-12</sup>

## PHVVP Symptoms

Symptoms are not necessarily related to the prolapse level and might be vague only. Yet, especially with extreme prolapse, might the lump immersing out of the hiatal introitus interfere with even simple daily activities as walking and sitting. Associate with significant degree of cystocele, enterocele, rectocele and enlarged vaginal hiatus are specific symptoms. Urinary urge and stress incontinence, urgency and frequency, urinary obstruction-masking stress incontinence might be evident with relaxation of the anterior pelvic floor compartment. Posterior pelvic floor compartment relaxation might be associated with fecal urgency and frequency, urge and stress incontinence. In general, POP might lead to sexual intercourse mechanical impairment; negatively affect the body image and self esteem of the affected patient and cause severe QoL impairment. The POP women frequently require manual assistance for urination and to defecation. The association between the site of anatomical defect, the nature and degree of prolapse and the symptoms is comprehended with the causative effect of the pelvic floor relaxation on the function and malfunction of the pelvic organs. Those understandings grounds proper goals targeting with pelvic floor reconstruction and ways for regaining the physiological pelvic organs functions, lost as prolapse occurred.<sup>13-16</sup>

## PHVVP Diagnosis: Anatomic and Functional Clinical Assessment

Thorough POP diagnosis is crucial for proper design of comprehensive therapeutic plan. Therefore, obtaining patient history is the key for understanding the patient's needs and expectations. Pre-interview filling of pelvic floor impact questionnaires might facilitate enlightening the various personal aspects of improvement necessitating debilitation related to the pelvic floor prolapse. Then, a pelvic examination under Valsalva maneuver is mandatory, as PHVVP co-exists frequently together with anterior and posterior vaginal walls prolapse. Thus, differential diagnosis and accurate mapping of the patient's whole pelvic floor is mandatory. It is easy to differentiate as the bladder neck is clearly seen when it is not emptied, as the anterior vaginal wall is normally rich with rugosa, the cervix or the dimpled points marking the sacro-uterine ligaments insertion are visible to define the vaginal apex and the posterior vaginal wall with eventual entero-rectocele is defined-able as well. Prolapse level of each and every site of the pelvic floor is to be properly determined, by any acceptable measurement method, both for therapy planning and for cure assessment. Other issues of importance are the vaginal mucosa status (local estrogen therapy might be considered to reinforce this tissue when atrophy is present prior to surgery), evidence of

urinary and fecal incontinence, hiatus dimensions and perineal body integrity. Functional impairments, related to the pelvic floor herniation process, such as urine and fecal storage and emptying problems and sexual intercourse difficulties are to be addressed when clinical pelvic floor assessment is carried out. All these above mentioned anatomical defects and functional deprivations might co-exist with various combinations and different prolapse degrees. The pre-operative clinical data collection should be furnished with some laboratory studies. Further to the standard pre-operative ECG, chest X-ray, blood and urine analysis, ultrasound scan might be of benefit to rule out co-existing pelvic organ pathology including urinary obstruction. In the presence of fecal storage or passage abnormality is an ano-rectal work-up indicated. The accurate place of urodynamic studies in terms of pointing the best therapeutic approach and prediction of cure or complication rates is in dispute. Many argue the benefit to be of no clinical value while others claim that the information provided enriches the understanding of the individual pathological backgrounds, hence improves the treatment.<sup>17-19</sup>

## PHVVP Diagnosis-QoL Assessment

Given that the main therapeutic goal is recreation the functional capacity of the pelvic organs rather than anatomical reconstruction of the supportive defects and restoration of the original pelvic floor architecture only, one must acknowledge the importance of QoL assessment tools. These tools, namely validated questionnaires, are crucial for both, pre-operative as well as post-operative evaluations. Comparison of the two will determine the true treatment value from the patient point of view. The surgeon's judgment was found to differ largely from the self reported patient's perspective, as the physician tends to strongly underestimate the patient's complaints this is partially explained with the complaints being relatively mild, thus not mentioned at the interview. Another bias leading to the surgeon's-patient's judgment discrepancies emerges out of slight differences with the questions presented to the patient at interview and on the questionnaires: The questionnaires were validated properly, while the frontal interview verbal communication varies profoundly. The use of pelvic floor oriented and validated questionnaires is of great importance for proper pre-operative evaluation and therapeutic plan design. Among the frequently used questionnaires are the IIQ-7, the UDI-6 as well as many others.<sup>20</sup>

## PHVVP Pathophysiology

The causative process leading to pelvic floor supportive impairment, yielding the PHVVP, is presumed to be multi factorial: Age, genetic connective tissue weakness, previous obstetrical

trauma and poor surgical technique while performing pelvic operations might all contribute to the unfortunate occurrence of this condition. Genetic factors, leading to connective tissue metabolism and biochemistry impairment, are important co-factors responsible to connective tissue weakening and POP formation. This explains the familial occurrence often seen with POP, and was demonstrated to be related to alterations with collagen total content and variants, cross linking, morphology and biodegradability. The female patient age is widely accepted as contributing to POP, especially with true procidentia. This age to POP correlation is mostly significant up to the sixth decade of life. This might be contributed to estrogen deprivation at the menopause. Vaginal delivery is strongly attached to future POP as the pelvic supportive components, mainly the levator ani muscles and endo-pelvic fascial ligaments, might be severely and irreversibly traumatized during the fetal journey through the birth canal. Previous pelvic surgery, especially hysterectomy and retropubic colposuspension, is accepted to be associated to further apical and entero-rectocele formation. This is probably due to endo-pelvic fascial damage attributed to hysterectomy and anterior deviation with the longitudinal vaginal axis as well as to an addressed pre-existing posterior pelvic floor supportive defects occurring with Colposuspension. Previous pelvic floor reconstructive surgery was shown to increase by 12 the incidence of further prolapse reoccurrence necessitating re-operation, and it was un-related to hysterectomy performed for non-prolapse reasons others found that 12 months post POP reconstructive surgery prolapse recurred with 58% of the patients.<sup>21,22</sup>

### **PHVVP-therapeutic Goals**

One should bear in mind the different surgeon's and patient's expectations and desires related to POP therapy. While the practitioner might be satisfied with goon anatomical restoration, the patient looks for the functional recreation mainly. There is a need for a holistic approach towards the patient's anatomical abnormalities and the related functional impairments, including urine and fecal control and sexual intercourse. Patient's unrealistic expectations with the therapeutic process should be identified and adjusted to the known operative curative properties regarding urinary and fecal incontinence, bladder over activity symptoms, sexual functions as well as body image. Co-existing occult urinary female stress incontinence should be diagnosed prior to surgery and dealt with an anti-incontinence concomitant procedure.

### **PHVVP Herniation Concept**

POP is actually bulging of viscera through weakened pelvic floor and vaginal walls. Terms used to describe the POP in general,

and particularly PHVVP could be easily replaced by simply stating the specific herniation process. Cystocele and urethrocele are then herniation of the anterior compartment of the pelvic floor. Uterine, uterine cervix and PHVVP prolapse are all central pelvic floor herniation and enterocele, rectocele and perineal body tear are herniation of the posterior compartment of the pelvic floor. Endorsement of this approach improves the understanding of the underlying process and points to the appropriate therapeutic tools elected for cure, based on the knowledge accumulated regarding hernia repair at other regions of the human body.<sup>23</sup>

### **PHVVP Reconstruction Architectural Design**

Correct pelvic floor holistic anatomic-functional approach should be based upon solid long lasting suspension of the vaginal vault apex to well established pelvic sustained structures. Among such are the Arcus Tendineus Fascia Pelvis (ATFP) and the Sacro-Spineous (SS) ligament. The first lays along the lateral border of the levator ani muscles, from the inferior pubic ramus and the obturator membrane anteriorly to the iscial spine posteriorly and the second connects the iscial spine to the sacrum. Another anchoring option is the pre-sacral fascia, which longitudely covers the sacral vertebra and provides a solid structure which might serve as a suspensory point to secure the vaginal apex to. Attaching the vaginal vault to one of these ligaments will yield a long lasting apical support, permitting restoration of the impaired pelvic floor and organs functions. Some advocates the pre-sacral fascia, as it is easily reached it is reached easily via the peritoneal cavity, either by laparotomy or by laparoscopy, while others are against because of relatively high rates of intra and post operative bleeding potential, prolapse recurrence and difficult vaginal access. The ATFP, being relatively easily accessed via vagina is elected by some for vaginal vault support, and others will go for the SS ligament, saying this is the most stable pelvic structure, hence providing the best and longest standing support. Deep pelvic dissection, wider than for the ATFP, is necessary for reaching the SS. The cardinal and the utero-sacral ligaments are other potentially usable supportive pelvic anchoring points, yet not easily identified and often obscure. Unfortunately, there is no comparative data to guide any evidence-based decision making regarding the preferred pelvic supportive connective tissue, rather than experts opinions.

### **PHVVP Non-mesh Repair**

The post hysterectomy prolapsed vaginal vault non-mesh repair operations are mainly done via vaginal approach as the abdominal rout might frequently requires mesh to bridge the gape between the vaginal apex and the anchoring point at the pre-vertebral fascia. For sexually non-active women, whenever



the vaginal sexual functions might be sacrificed, colpectomy or vaginal obliteration (Le Fort operation) is a therapeutic option. These relatively safe and simple operations are carried out vaginally, yet prolapse recurrence rate was not established. The vaginal capacity is significantly and irreversibly reduced with these operations. If sexual intercourse function should be preserved, the vaginal capacity is to be maintained. Then are the commonly performed vaginal vault prolapse non-mesh repair done by apical suspension to the SS ligament. The sacro-spineous fixation operation requires deep para-rectal pelvic dissection and is eventually related to significant intra-operative bleeding. This operation was reported to be complicated by post-operative dyspareunia, buttock pain, urinary and fecal incontinence, cystocele and rectocele formation, altered defecation and constipation, bladder injuries, urinary retention and infections. The most troubling disadvantage reported to be attached to this operation is an acceptably high recurrence rate. Neither simple colporrhaphy, with or without plication of the utero-sacral ligaments, nor sacro-spineous and sacral colpopexies, seem to be the preferred procedures for repairing vaginal prolapse. Some authors observed that these surgical modalities are associated with a to up 58% recurrence rate in terms of objective POP scoring and prolapse related subjective symptoms while others reported on a recurrent surgery rate for pelvic floor reconstruction of 30%. True surgery related QoL improvement was never well addressed with these operations.<sup>24-30</sup>

### **PHVVP Surgical Suspension with Mesh Implants for Recurrence Rate Reduction-justification & Reasonability**

Given that recurrence rate following traditional vaginal apex re-suspension it unacceptably high and that underlying causative genetic, traumatic and surgical co-factors contributes to progressive weakening of the endo-pelvic fascia, one would endorse a recurrence reducing surgical method. The mesh implant concept was previously proven as recurrence reduction method with abdominal wall herniorrhaphy and was later implemented for the pelvic floor herniation repair as well.<sup>31</sup>

### **PHVVP Surgical Suspension with Mesh Implants Special Perspectives**

Unlike with abdominal wall hernia vertical mesh repair, the vaginally horizontal implanted meshes are under relatively high level of physical pressure. This makes the vaginally implanted meshes prone to further prolapse, unless well secured to solid pelvic structures as the SS, the pre-sacral fascia, the ATFP or the utero-sacral ligaments. The vaginally implanted meshes are covered by thin and fragile layer of mucosa in comparison with the thick abdominal wall coverage; hence erosion and mesh

exposure are possible post operative complication. Anti erosive surgical steps are to be taken in order to minimize mucosal erosion and vaginal mesh protrusion hazard. Among these anti erosive steps are the well respected tension free principles for herniation repair, for both-vaginal wall tissue and mesh. Refrain from excessive vaginal mucosa trimming and dissecting below the sub-mucosal fascia to preserve blood supply and nerve endings might contribute to reduce the post-operative tissue tension as well, avoiding ischemia, mal healing and tissue necrosis, thus reducing the mesh exposure incidence. There is much importance of replacing significant and sufficient parts of the endo-pelvic fascia, beyond the borders of the defected endo-pelvic fascia and pelvic floor herniation process, with the artificial synthetic fascia which is the mesh. This is best done by well spreading the mesh from one pelvic side-wall to the other, from the urethra and bladder neck to the vaginal apex, through the posterior compartment all the way down to the perineal body. Then are the pelvic organs not supported with the defected endo-pelvic fascia any more but rather with the fascia replacing synthetic mesh. Wide dissection is generally required for achieving proper repair and meticulous support ensuring. Ligament through passing with the mesh arms is the preferred anchoring method, as it probably yields long lasting support in comparison with suture mesh fixation methods. The pre-operative surgical field sterilization achieved with abdominal operations could never be gained with vaginal surgery, as this will be never exceed the level of "clean-contaminated" sterilization degree, due to inability to totally disinfect the vagina. Hence, especially anti-infectious designed new mesh types were requested. Macro-porous and mono-filament meshes discourage bacterial growth and nesting and thus are best used for vaginal pelvic floor reconstruction.

### **PHVVP Surgical Suspension with Mesh Implants for Recurrence Rate Reduction-evolution of the Concept**

Though the best approach for restoration of vaginal apical support among the commonly utilized abdominal and vaginal routes remains controversial, the utero-sacral, SS, ATFP and Sacral ligaments vault suspension are the most anatomical among the repairs. Hence, it is most unlikely that these ligament support for the vaginal apical prolapse will create a predisposition to future anterior or posterior vaginal vault defects or compromise vaginal function. Given that vaginal vault herniation is the result of separation of the pubocervical fascia from the recto-vaginal and paracolpion fascia, resulting in an apical enterocele, it should be corrected by meticulous herniorrhaphy including reattachment of the vaginal vault to one of the above mentioned ligaments. Early attempts to apply

the well accepted approach of simple mesh implantation with abdominal wall herniorrhaphy for recurrence rate reduction to the POP repair surgery ended with disappointing results. The failure and mesh exposure rates were extremely high and these attempts were stopped. The reasons for failure were better understood later, as the intra-abdominal forces directed to the pelvic floor implanted mesh and the relatively poor mucosal coverage were acknowledged. These considerations encouraged the design of an innovative procedure for the correction of the apical vaginal support defect, through replacement of the utero-vaginal ligament encoding with a synthetic sling, positioned at the levator plate level space via vaginal approach to the para-rectal area, performed in a daycare setting.<sup>23-25</sup> The novel posterior intra-vaginal sling (PIVS), entailing minimal invasiveness via a vaginal approach together with anatomical restoration of the uterosacral ligament suspension of the vaginal apex, performed in a daycare set-up. Magnetic resonance imaging showed that significant improvements in the restoration of the vaginal configuration were achieved in patients who underwent PIVS. The PIVS operation facilitates uterine conservation, even in the event of advanced uterine prolapse. The restoration of the uterosacral ligaments support enables the surgeon to re-suspend the uterine isthmus, hereby avoiding the necessity to perform vaginal hysterectomy for the treatment of uterine prolapse. Thereafter further developments occurred: The mesh against slings debate rose up; questioning whether the preferred way for POP repair is replacing the specific broken endo-pelvic ligaments with synthetic sling is adequate. Others felt that the whole endo-pelvic fascia should be replaced with large mesh from one side-wall to the other and from the pubic bone towards the sacrum is desired, similar to the way mesh implants are used with abdominal wall herniation repair and ending with large mesh size. The best mesh pelvic fixation points and fixation method are another field of uncertainty with POP vaginal mesh implantation: The SS, AFTP, pre-sacral and the sacro-uterine ligaments were all advocated as suitable for pelvic mesh anchoring with variety of fixation methods. Some feel very strongly that the only long lasting fixation method is passing wide mesh arms through the ligaments, others simply sutured the mesh to ligament and various stapling devices were introduced as well. All the above mentioned influence the needed width of pelvic dissection, hence the needed training and skills as well as the potential operative hazards.<sup>32-37</sup>

### Principles of Mesh Reconstruction

The support facilitating and enhancing mesh should be secured to the vaginal apex on one edge and to the elected supportive structure-the SS, utero-sacral, pre-sacral or the AFTP ligaments

on the other edge. The mesh should substitute the herniation causing weakened fascia that led to prolapse of the central, anterior and/or posterior pelvic floor compartments. Thus, the PHVVP, as well as the frequently co-existing cystocele and/or entero-rectocele are to be properly corrected simultaneously. In case of co-existing cystocele should the mesh provide support to the whole anterior pelvic floor compartment and be secured also to the anterior end of the AFTP, while with co-existing entero-rectocele should the mesh provide support to the posterior pelvic floor compartment and be secured also to the perineal body. These additive secures will serve to stabilize better the mesh and avoid displacement and recurrent prolapse.

### PHVVP-surgical Pearls

Tension free concept for the mesh placement and attachment as well as the mesh covering tissue should be kept in mind at all times when reconstruction of damaged pelvic floor is undertaken. This will reduce tissue ischemia, tissue necrosis, mal healing and later mesh exposure. Preservation of viable blood vessels and nerve endings by deep and full thickness infra-fascial lateral dissection of the vaginal wall will contribute for mesh exposure reduction. This is remarkably facilitated with hydro-dissection which is helpful for getting into the true vesico-vaginal and recto-vaginal spaces leads to lower erosion rates. A non-ischemic colpotomy closing suture knotting and minimization of the vaginal through cut are also valuable anti ischemic measures. Extensive mucosal trimming for tissue tailoring while normal dimensioned vaginal recreation might end with tensioned vagina, thus to further mesh exposure. Important is meticulous mesh flattening before vaginal cut assembling, to avoid post operative infra-mucosal mesh folding and pain, including dysmenorrhea. Mesh position securing, either by ligament passing mesh arms or with suturing, should ensure that the mesh is properly spread to replace the whole herniation causing defected endo-pelvic fascia.

### PHVVP Versus “*in situ* uterus” VVP Repair

The uterus un-removed offers the surgeon solid central pelvic encoring points such as the cervical ring or the uterus itself. These organs might then both be attached to various solid structures at the pelvic side-walls, as the SS, sacro-uterine, AFTP or the pre-sacral ligaments. Being connected to the cervico sacral, cardinal and cervico-pubic ligaments provides the spared cervical ring extra sustainability for the pelvic floor, arising out of recruitment these web architecture structures to the pelvic reconstruction. This challenges the widely endorsed common practice of reflective appointment for vaginal hysterectomy with uterine prolapse diagnosis, trained at many centers and performed routinely around the globe. Solid data

regarding the question whether should the prolapsed uterus be removed are not available currently. Yet, some level 2 evidence supports the preservation of the prolapsed uterus or the uterine cervix at least, guiding a potential change with the common attitude of automatic indication towards vaginal hysterectomy whenever POP is present. The direct disadvantages of hysterectomy regarding pelvic floor reconstruction are the damages to the endo-pelvic fascia integrity, vasculature, blood supply and innervation and the deprivation of the advantage of using the cervical ring and the web of connected ligaments for providing extra strength to the pelvic floor architecture. All these are extremely important for maintaining further pelvic floor sustainability and functions. Performing hysterectomy concomitantly with mesh pelvic floor reconstruction increases significantly the risk of post operative mesh vaginal exposure and the need for further operative intervention to cure this complication. Not rare is the occurrence of vaginal shortening after hysterectomy, to such degree that impairment of sexual intercourse. Except of the negative influence on the pelvic floor structure and functions, entails vaginal hysterectomy many operation related complication, some of are health and life threatening, and it might also physiologically mutilate the disregarded hysterectomised patient's body image and self esteem. Minimally invasive novel methods for the treatment of menorrhagia, endometrial polyps and uterine myomas as well as increasing public awareness against preventable hysterectomies lead towards preservation of the prolapsed uterus.<sup>38-47</sup>

### PHVVP Repair-vaginal vs. Abdominal Approach

There are two surgical access routes for reconstructive pelvic surgery to correct POP: The abdominal approach (either by laparotomy or via laparoscopy) and the vaginal approach. Though the best approach for restoration of vaginal apical support among the commonly utilized abdominal and vaginal routes remains controversial; the pelvic ligament vault suspension is the most anatomical among the repairs. Hence, it is most likely that the utero-sacral, SS, AFTP and Sacral ligament support for the vaginal apical prolapse will yield a long lasting vault suspension and restoration of the vaginal functions. For the last decade, various surgical modalities for curing POP through reconstruction of the pelvic floor have been advocated, mainly modification of the colpo-sacral and colpo-sacrospinal fixations, using vaginal or abdominal approaches, via laparotomy or laparoscopy. These operations were associated with well documented complications such as mesh erosion, dyspareunia, buttock pain, urinary and fecal incontinence, altered defecation and constipation, bladder injuries, urinary retention and infections, cystocele and rectocele formation and protrusion, and other disadvantages such as long operative time, slow return to normal living activities and great costs.

Given that the vaginal vault herniation is the result of separation of the pubo-cervical fascia from the recto-vaginal and para-colpion fascia, resulting in an apical enterocele, it should be corrected by meticulous herniorrhaphy with reattachment of the vaginal vault to the utero-sacral ligaments. The vaginal approach for POP reconstructive operations is associated with fewer complications and results in a shorter rehabilitation period than the abdominal route, whereas hysterectomy is widely performed concomitantly whenever the uterus is significantly prolapsed. However, there is no clear evidence supporting the role of hysterectomy in improving surgery outcome. The new minimally invasive procedure for apical prolapse suspension, as the PIVS for correction of advanced uterine prolapse, enables uterine preservation. The issue of vaginal hysterectomy within the context of POP was addressed earlier with regard to the potential additive curative effect in terms of reduction of the POP post-operative recurrence rate and the influence of future QoL. No advantage was attached to hysterectomy in the surgical cure of POP.<sup>19-26</sup> Replacement of the broken uterosacral ligaments applying PIVS provides adequate uterine re-suspension, hereby permitting uterine preservation while treating advanced uterine prolapse.<sup>48-52</sup>

### PHVVP Repair-laparoscopic Approach

Laparoscopic suspension of prolapsed uterus or prolapsed vaginal vault is feasible and has durable curative results, yet it requires advanced laparoscopic skills and an experienced laparoscopic center as severe damage might occur to the surrounding organs during operation. This is done by suturing mesh to the anterior and posterior aspects of the vaginal vault and securing it to the longitudinal sacral ligament at the level of sacral 2<sup>nd</sup> or 3<sup>rd</sup> spine. Post operative dyspareunia is claimed to be reduced in comparison with vaginal reconstruction but this was not proved. The advanced laparoscopic surgical skills required for laparoscopic sacro-colpopexy include deep pelvic floor tissue dissection capability as well as familiarity with suturing and knot tying. Thus, this procedure is reserved only for the very well trained end experienced laparoscopists. However, when properly performed is the laparoscopic approach for sacrocolpopexy claimed to be as effective as the abdominal one, while the operative time is significantly longer and hospitalization, blood loss and rehabilitation period are much reduced. Due to the necessitated meticulous and proper prior training remained the laparoscopic sacral colpopexy unpopular at many medical centers.<sup>53-57</sup>

### PHVVP-isolated Apical Support Defect Mesh Repair

When the apical vaginal vault is prolapsed while the lower segment of the anterior and posterior vaginal walls are well suspended, apical correction only is needed. This might be

achieved either via the abdominal cavity by laparotomy or by laparoscopy, or vaginally. The abdominal approach permits exposure of the pre-sacral longitudinal fascia for suspension of the prolapsed vaginal apes, yet frequently implanted mesh is required for bridging over the anatomical gap in-between the two structures. One mesh end is to be fixed to the pre-sacral exposed and bare 4 to 6 square cm of fascia, avoiding the rectal vessels. The other mesh edge is fixed to the exposed vaginal apical wall. Often the bladder and the rectum must be dissected away from the vaginal apex for about 6 to 8 square cm permitting adequate and sufficient mesh appliance in order to provide long standing support. Permanent sutures should be used for the mesh to soft tissue fixation. The suture must not be too tight to reduce the occurrence of tissue ischemia, necrosis and breakdown. Other possible fixation methods are staples, yet safety and durability were not reported. At the end the mesh is to be covered with peritoneum to avoid later intestinal damage. Vaginal apical suspension might also be achieved via vaginal approach, either using the AFTP or to the SS ligaments as anchoring points. The ligaments are reached via colpotomy, para-rectal or para vesical dissection and iscial space development. Displacement of the bladder, rectum and small bowels might be necessary for ligamentary palpation or visualization. Occasionally is the vaginal vault long enough for direct suturing to the suspensory ligament, yet-mesh implants are probably important for avoiding recurrence. Unless done bilaterally, which is a rather complicated operation, vaginal axis lateral deviation is induced, causing further potential dyspareunia. The durability of this operation is not well established. Many advocates mesh implantation for sustained correction of vaginal vault prolapse, when performed via vagina. The mesh should be fixed either to the AFTP or to the SS ligaments on both lateral pelvic sides and to the vaginal apex medially.

### **PHVVP-apical and Anterior Vaginal Wall Support Defect Mesh Repair**

When the apical vaginal support defect is combined with anterior vaginal wall defect (cystocele), should the apical reconstruction (chapter 22) be followed with anterior vaginal wall reconstruction to complete the pelvic floor repair. This might be done by classical anterior colporrhaphy most of the times, if only the potential supportive characteristics of the vesico-vaginal endo-pelvic fascia are judged to be sufficient for long lasting prolapse correction. There are not any existing objective tools to guide such decision, hence must the surgeon base his preferred approach upon clinical impression related to the tissue nature and personal and family history. Elects the surgeon to perform a classical anterior colporrhaphy, should he make a longitudinal

medial anterior wall cut and free the vaginal wall from the bladder Detrusor muscle. Then should he place some transverse sutures to approximate both sides of the vesico-vaginal endo-pelvic fascia to recreate a dissent support for the bladder, trim the un-necessary mucosa to tailor a vaginal at normal capacity and length and close the surgical cut. Should the surgeon decide that the particular pelvic floor might be not appropriate for homologous repair, might a mesh implantation be desired. When such occurs, should the surgeon add to the apical support operation anterior vaginal wall mesh re-enforcement. The mesh should preferably cover the whole anterior wall fascial supportive defect, and be spread from one pelvic side wall to the other, from anterior to posterior, to replace literally the whole anterior compartment pelvic endo-pelvic fascia and prevent recurrent prolapse. Achieving proper mesh placement requires then a rather large para-vesical dissection, along with the bony pelvis up to the iliac spines laterally and posteriorly and to the pubic bone upwards. The mesh should be flattened properly to prevent further lump formation and vaginal pain. The mesh and the overlying whole thickness and well blood supplied vaginal mucosa should be left totally tension free to avoid tissue ischemia, mal-healing and mesh exposure. The mesh should be well attached to solid intra-pelvic ligament to prevent support brake down. The mesh should be also secured to the fascial ring of the uterine cervix or to the vaginal apex at the insertion point of the former sacro-uterine ligaments to recruit the endo-pelvic ligaments for improved supportive results. Mesh fixation to the para-urethral tissue is desired as well to promise latter stabilization of the construction. Normally, mucosal trimming is avoided or limited with mesh implants to reduce the possible tissue tensioning and ischemia.

### **PHVVP-apical and Posterior Vaginal Wall Support Defect Mesh Repair**

When the apical vaginal support defect is combined with posterior vaginal wall defect (recto-enterocele), should the apical reconstruction (chapter 22) be followed with posterior vaginal wall reconstruction to complete the pelvic floor repair. This might be done by classical posterior colporrhaphy, if only the potential supportive characteristics of the recto-vaginal endo-pelvic fascia are judged to be sufficient for long lasting prolapse correction. There are not any existing objective tools to guide such decision, hence must the surgeon base his preferred approach upon clinical impression related to the tissue nature and personal and family history. Elects the surgeon to perform a posterior Colporrhaphy only, should he make a longitudinal medial posterior wall cut and free the vaginal wall from the rectum and enterocele herniation peritoneal sac. Then should he place a tobacco-



pouch round suture to reduce the enterocele herniation and some transverse sutures to approximate both sides of the recto-vaginal endo-pelvic fascia to recreate a dissent support for the rectum. The distant levator muscles are to be approximated in a similar way to form a functional perineal body. The un-necessary mucosa is trimmed to tailor a vagina at normal capacity and length and then the surgical cut the closed. Should the surgeon decide that the particular pelvic floor might be not appropriate for homologous repair, might a mesh implantation be desired. When such occurs, should the surgeon add to the apical support operation posterior vaginal wall mesh re-enforcement. The mesh should preferably cover the whole posterior wall fascial supportive defect, and be spread from one pelvic side wall to the other, from anterior to posterior, to replace literally the whole posterior compartment pelvic endo-pelvic fascia and prevent recurrent prolapse. Achieving proper mesh placement requires then a rather large para-rectal dissection, along with the bony pelvis up to the iliac spines laterally and posteriorly and to the perineal body anteriorly. The mesh should be flattened properly to prevent further lump formation and vaginal pain. The mesh and the overlying whole thickness and well blood supplied vaginal mucosa should be left totally tension free to avoid tissue ischemia, mal-healing and mesh exposure. The mesh should be well attached to solid intra-pelvic ligament to prevent support brake down. The mesh should be also secured to the fascial ring of the uterine cervix or to the vaginal apex at the insertion point of the former sacro-uterine ligaments to recruit the endo-pelvic ligaments for improved supportive results. Mesh fixation to the perineal body is desired as well to promise latter stabilization of the construction. Normally, mucosal trimming is avoided or limited with mesh implants to reduce the possible tissue tensioning and ischemia.

### **PHVVP-apical, Posterior and Vaginal Hiatus Support Defect Repair**

When the apical vaginal support defect is combined with posterior vaginal wall defect (recto-enterocele) and with widely opened vaginal hiatus should the apical and posterior compartment reconstruction (chapter 24) be followed with reconstruction of the perineal body to complete the pelvic floor repair. This might be done by classical perineorrhaphy most of the times, if only the potential supportive characteristics of the recto-vaginal endo-pelvic fascia are judged to be sufficient for long lasting correction of the relaxed tissue. When the ano-vaginal septum is extremely poor, both sides the levator plate recruitment might be necessary for erection of solid perineal body and reducing the vaginal opening dimensions. Was the posterior wall reconstruction made with mesh, could the perineal body reconstruction be use

for further covering the mesh, hence reducing the post operative mesh exposure hazard.

### **PHVVP-apical, Anterior and Posterior Vaginal Wall Support Defect Repair**

When the apical vaginal support defect is combined with anterior and posterior vaginal wall defects (cysto-recto-enterocele), should the apical reconstruction (chapter 22) be followed with anterior and posterior vaginal wall reconstruction (chapters 23&24) to complete the pelvic floor repair.

### **PHVVP-repair of Apical Support Defect Combined with Stress Urinary Incontinence**

When the apical vaginal support defect is combined with mid urethral supportive defect (occasionally forming urethrocele), should the apical reconstruction (chapter 22) be followed with an anti urinary incontinence procedure, usually a mid urethral support reconstruction to complete the pelvic floor repair. One of the trans-obturator or retro-pubic TVT slings might be chosen better than the newly developed “mini slings”, in case that an anterior mesh was implanted, as the required deep para-vesical dissection might impair the tissue ability to harbor these mini-sling’s tips and they might not be well fixed.

### **PHVVP Mesh Reconstruction-mesh Choice**

Accurate diagnosis of all the prolapse features and site specific support requirements identification are mandatory for proper mesh choice. It is the presence of isolated apical supportive defect only at the central pelvic floor compartment or any additional anterior and/or posterior compartments prolapse that determine the requested mesh shape. It is the coexistence of urinary stress incontinence that indicates the need for additional mid-urethral support. The elected mesh or combination of meshes should be providing support for all the prolapsed pelvic floor sites. One must bear in mind that some commercially available anterior compartment meshes are designed for cystocele repair only while others provides the possibility to suspend the prolapsed uterus by cervical ring attachment, thus permitting it to be preserved. Other meshes provide support the mid urethra, concomitantly with anterior compartment reconstruction, hence avoiding the need for additional tape to support the mid-urethra separately. The later ones cure not only the anterior compartment prolapse only but the uterine prolapse and/or stress urinary incontinence simultaneously with the cystocele repair. Other meshes are designed for posterior compartment reinforcement, some of provides the possibility to support the prolapsed uterus or vaginal apex at the same time. Whenever there is a need to treat several sites of pelvic supportive defects more than

one mesh might be needed. There should be a dissent and convincing published body of evidence to prove the safety and efficacy of the specifically chosen mesh. The surgeon must be properly trained with any new mesh by an experienced trainer and familiar with potential hazards' including prevention and management of these. The mesh texture need to be as soft and light as possible, none shrinking, small in dimensions, yet sufficient for complete replacement of all defected parts of the endo-pelvic fascia and pelvic floor herniation. Thorough defected endo-pelvic fascia substitution with the artificial fascia is crucial for insuring long lasting support. Host against graft and graft against host reaction formation should be ruled out according with any particular mesh prior to usage, so should any mesh related bacteria nesting or harboring. This is generally the case with type 1 mono-filament macro-porous knitted meshes, not interfering with macrophages migration. Long lasting anchoring method were reported to involve ligament through passing mesh arms, thus the particular mesh attachments to the pelvic chosen supportive points should be proved before hands for long lasting support, preferably with mesh arms through AFTP or SS ligaments anchoring. Mesh and arm delivery systems for mesh individually prepared or pre-cut kits should be proven to yield the desired correct mesh and arms placement at the pelvic floor. Some pre-cut meshes might be too small to provide the necessary complete coverage of the whole fascial defects, thus easier to place because less dissection is required. Others might provide relatively easy arm placing devices, but at the price of improper arm passage at the deep ligaments of the pelvis for appropriate high support. These meshes might be prone to operative failure and recurrent prolapse. One should not be tempted for these easy to apply kits but rather go for the highly curative ones. Bio meshes where not proven to yield any advantage over the synthetic ones and one should not endanger his patients with bio-hazards. Smilingly, the absorbable meshes where not reported to entail any superiority and one should ask himself is there any potential benefit of a vanishing mesh in herniation repair at all. The list of available commercially manufactured products expends fast and the existing ones are regularly re-shaped, thus there is no point in referring to any particular currently available mesh. With this atmosphere of many newly designed meshes popping up almost monthly, one must be extra couches when choosing his own mesh. Of huge importance is solid clinical data, proving high cure rate and low rate of complications of mild nature. One should seek for proper training before adopting any new operation and maintain his skills with frequent operation performance.<sup>58</sup>

### PHVVP Mesh Reconstruction Related Complications

**A. Intra-operative complications:** Superficial or deep bleeding might occur during operation, related to arterial or venous

breakdown. While dissecting or at needle insertion might the neighboring viscera be perforated; this could involve the urethra, the bladder-at the ureteral orifice or remote from there, the small or large intestine.

**B. Early post-operative:** At the post-operative course might partial or complete bladder outlet obstruction present, field infection could be evident, hematoma formed, vaginal, pelvic or at the thigh pain could appear- with or without neurological deprivation.

**C. Late post-operative complications:** Chronic vaginal, pelvic or at the thigh pain and dispareunia were reported to complicate prolapse reconstructive surgery, with or without neurological deprivation, so was also vaginal mesh protrusion and bladder or rectal mesh protrusion. There is some unclearness whether the last ones occurred during or after the operation. Sacral abscess formation and vesico and recto-vaginal fistula are severe and health threatening post operative complications related to POP reconstruction. Mesh exposure has been described to complicate the postoperative course of these procedures in about 15% of the patients, other complications are relatively rare, yet important because of their potentially sever consequences. All the above mentioned complications were reported to complicate the abdominal as well as the vaginal operations, with type 1 or non type 1 mesh.

### PHVVP Mesh Reconstruction-reducing Operative Complications Rate

Proper training, skill maintaining and good surgical technique keeping are always the golden keys for any operative complication rate reduction.

Avoiding intra-operative bleeding: Hyhydro-dissection first, than dissecting at vessel free anatomical planes will reduce vessel breakage and bleeding. So will sharp dissection and proper needle passing through a-vascular tissues.

Avoiding intra operative urethral, bladder and intestinal injury: Meticulous dissection, according with standardized and pre-designed surgical steps and respecting anatomy alternating adhesion and fibrosis related to prior surgeries, might contribute to avoiding visceral operative damage.

Avoiding early post-operative bleeding: Proper and meticulous intra-operative hemostasis and use of coagulation inducing agent when indicated will definitely reduce post operative bleeding potential. So might the usage of vaginal tampon.

Avoiding post-operative pain: Post-operative vaginal and pelvic pain and dispareunia might be reduced with proper placement and flattening of the mesh and with tension free surgical technique for both-tissue and mesh. Radiated thigh and leg pain are reduced by properly passing the mesh arms within the pelvic structures-away from neighboring situated nerves.

Avoiding post-operative urinary obstruction: Urinary obstruction will be widely avoided by proper non-tension mesh placement at the bladder neck level.

Avoiding post-operative mesh exposure: Choosing the type-1 mesh for bacterial infection avoiding, vessel and innervation sparing full thickness vaginal wall dissection, shortening the vaginal surgical cuts as much as possible, meticulous hemostasis, non-tensile mucosal closing, minimal mucosal trimming-all these will reduce tissue ischemia, necrosis, mal-healing and risk for mesh exposure.

Avoiding post-operative vaginal mesh bladder or rectal mesh protrusion or fistula formation: Meticulous anatomically wise dissection at the proper inter organ planes as well as tension free surgical techniques for both-tissue and mesh and blood vessels preservation will prevent late visceral mesh injury.<sup>59</sup>

### **PHVVP Mesh Reconstruction-management of Related Complications**

Intra-operative bleeding: Apply direct pressure upon bleeding zone, either manually or by packing, if needed - use advanced hemostatic agents, consider selective arterial embolization or pack and finish the procedure. Note: Bleeding might be extra-peritoneal, thus large in volume, be ready for blood transfusion.

Intra operative urethral injury: Vaginal repair is possible with 3 different anatomical tissue layers: Urothelium, connective tissue and vaginal mucosa. Visualize urethral patency; keep the bladder drained for a week, continuing the mesh placement is optional.

Intra operative bladder injury: Evaluate damage with cystoscopy whenever bladder injury might be suspected. Unless ureteral orifice is involved-vaginal repair is possible, otherwise repair abdominally. Correction is best performed with 3 different anatomical tissue layers: Urothelium, connective tissue and vaginal mucosa. Consider use of ureteral catheter; visualize ureteral patency, keep the bladder drained for a week. Controversy exists regarding mesh implantation after cystotomy, continuing the mesh placement is optional only if the bladder injury is mild in nature and leakage is not anticipated.

Intra operative small intestine injury: If minor-repair and proceed with operation, otherwise-repair but refrain from mesh placement.

Intra operative large intestine injury: If small-repair, otherwise consider diversion and colostomy. Abort procedure and do not implant mesh to avoid infection and protrusion.

Early post-operative bleeding: If patient is stable hemodynamically-use vaginal tampon and monitor vital signs as well as hematocrit levels and ultrasonic imaging of the hematoma. Consider hematoma evacuation only if clinically significant, provide preventive antibiotics.

Early post-operative pain: To a certain level of post operative pelvic pain is frequent and successfully dealt with by oral analgetics. When excessive or referred pain is evident, suspect nerve involvement or pelvic hematoma, take necessary diagnostic steps and act accordingly by removing the mesh or evacuating the hematoma.

Early post-operative urinary obstruction: Complete post-operative urinary obstruction is rarely improved with expectancy, thus early intervention to relieve increased mesh tension is indicated. This is easily achieved by re-opening the primer surgical cut at the anterior vaginal wall, clamping the mesh on midline sides and gentle down-pulling, avoiding urethral damage as well as exaggerated mesh loosening. If just partial obstruction is diagnosed, and the residual urine volume is only moderately increased, re-catheterization is probably sufficient as spontaneous relief occurs frequently.

Post-operative vaginal mesh protrusion: Small mesh exposures, occurring after abdominal colpo-sacro-pxy or vaginal reconstruction, might it be subject to local estrogens for a month time. There after-surgical removal is indicated if persistent. With large mesh exposures or with non-type 1 mesh surgical removal should be performed as first measure as conservative treatment would be fruitless.

Late post-operative pain: Mesh exposure or retraction and vaginal tissue fibrosis might cause vaginal, pelvic, buttock or thigh pain, with or without neurological deprivation. Local treatment with estrogen and anti inflammatory might reduce pain, otherwise intervention should be considered for exposed mesh removal or mesh tension release. Chronic irradiated pain to lower extremity, especially when combined with neural deprivation, calls for mesh arm removal. This is not easy to perform and entails limit results. Late post-operative discharge: Chronic vaginal discharge might be due to mesh exposure or vaginal granulation tissue formation; thus removal of these is indicated.

Post-operative dyspareunia: Mesh exposure or vaginal wall tissue fibrosis should be suspected, especially if the partner is inconvenient during sexual intercourse as well. Thus, removal of these is indicated.

Post-operative vaginal mesh bladder or rectal mesh protrusion and vesico or recto-vaginal fistula: These should be dealt with surgical therapy. The mesh should be removed and injured viscera should be treated. Surgeons should be familiar with and well trained for managing these complications, yet one should seek for proper assistance with decision making as well as with the requested surgical measures.<sup>60-66</sup>

### **PHVVP Mesh Reconstruction-anatomic and Functional Clinical Outcome Assessment**

After completion of the therapy, the accurate outcome is to be properly assessed, especially on research setups and when

adopting new techniques. The post operative anatomical pelvic floor under Valsalva maneuver status should be assessed properly using an accepted prolapse quantification method as the Baden or the ICS POP-Q system. The surgeon's judgment was found to differ largely from the self reported patient's perspective, as the physician tends to strongly underestimate the patient's complains. This is partially explained with complains being relatively mild, thus not mentioned at the interview. Another bias leading to the surgeon's-patient's judgment discrepancies emerges out of slight differences with the questions presented to the patient at interview and on the questionnaires: The questionnaires were validated properly, while the frontal interview verbal communication varies profoundly. The patient is frequently reluctant to report dissatisfaction with the therapeutic results, considering that as impoliteness regarding the surgeon. Hence, the objective and independent patient self assessment validated questionnaires are an essential tool for judgment of the accurate value of POP as for any other medical procedure. Thus, the accurate assessment of the various aspects of the pelvic floor relaxation related QoL is essential. The use of pelvic floor oriented and validated questioners is of grate importance both-for proper pre-operative evaluation and therapeutic plan design and for post operative cure judgment as well. Among the frequently used questioners are the IIQ-7, the UDI-6 and many others.<sup>67</sup>

### **PHVVP Mesh Reconstruction-reducing Failure Rate**

Proper training, skill maintaining and keeping good surgical technique are the keys for failure rate reduction. Proper mesh arms introduction to accurate points at SSL & AFTP on one side and secure anchoring to the vaginal apex or preferably to the cervical ring if not removed earlier on the other one, are crucial for long lasting apical support. Proper mesh flattening and fixation to both lateral pelvic aspects prevent mesh shifting and further lateral supportive defects.

### **PHVVP Mesh Reconstruction Failure Management**

Vaginal vault prolapse re-occurrence might be due to detachment of the mesh arms from the anchoring pints at the supporting pelvic ligaments or to vaginal vault, or to mesh shifting from lateral sidewalls. With either, should the failed surgical technique not be repeated but rather replaced by another technique. Thus, a failed vaginal procedure could be followed with an abdominal one and vice versa. As surgeons are generally familiar mainly with one single surgical method, referring the patient to an experienced college should be considered.

### **PHVVP Mesh Reconstruction-proper Patient Selection**

The only indication for supporting the prolapsed vaginal apex is clear diagnosis of such. Hence, only patients with true PHVVP should be appointed to apical reconstructive surgery. Relative contra-indications might be previous pelvic irradiation, immunodepressive state, active infection, Systemic steroid use and poorly controlled diabetes. Some of these patients might be subject to other therapeutic and palliative modalities as pessary placement or colpoclesis operation. Adoption of these guidelines will insure success and reduces avoidable failures.<sup>68</sup>

### **PHVVP Mesh Reconstruction-patient Informed Consent**

Prior to enrolling for surgical reconstruction of pelvic floor relaxation must be patient informed consent be obtained. This should particularly focus on the post operative anticipated anatomical and functional prognosis including sexual activity and urine and feces storage and leaking problems. Patient's expectations from therapy, regarding each deferent aspect of physical function as well as QoL improvement and impairment, arising from conditions related to POP and repair should be discussed. The post operative course including sexual and other physical activity restrictions, vaginal bleeding, discharge and pain, pointing the expected level and duration of each detailed feature should be pictured. The raw existing data concerning non-mesh against mesh implantation operations recurrence rate must be presented, as well as other data concerning mesh implantation, complications nature and rate, specific surgeon's training and experience and other commonly performed operations. All these will properly prepare the patient to the operation she is scheduled for, re-adjust her expectations and reduce unrealistic fantasies and improve satisfaction.

### **PHVVP Mesh Reconstruction-pre-operative Measures**

The operation related morbidity was never proved to reduce with prophylactic antibiotics, enema, bowel preparation, lower extremities bandaging, indwelling urethral catheter and even vaginal anti-septic lavage. Nevertheless not supported by any solid data, these measures are widely used for theoretical preventive benefits.

### **PHVVP Mesh Reconstruction-intra-operative Safety Measures**

Bladder drainage with urethral catheter was never proved as beneficial in terms of urethral and bladder injury reduction; some feel though that un-emptied bladder provides better burdens anatomical identification, thus correct dissection and bladder protection might be facilitated with a filled bladder. The mode of anesthesia was shown to have no influence on cure



rates and safety levels; intra operative cough test was not proved to reduce the failure rate of the anti incontinence surgical steps. Some do feel that performing this non-physiological diagnostic measure might contribute to elevation of post operative bladder outlet obstruction rate. No data supports the routine use of anti coagulant medications, neither is performance of routine diagnostic cystoscopy, either prior to surgery or at completion of the operation, unless iatrogenic bladder injury is suspected. Rectal examination was advocated at after posterior compartment mesh implantation, as rectal injury was reported with such. Vaginal routine tampon packing at the end of surgery never proved efficacy with improving cure or with post operative bleeding reduction. On the other hand this is causing significant discomfort and even pain to the patient.

### **PHVVP Mesh Reconstruction-postoperative Measures**

**Pain management:** The post-operative pain level is usually less than 5 according with a visual analog pain scale ranging 0 to 10. This is frequently dealt with oral analgesic medications repeated every 3 to 5 hours for 1 to 2 days. More effective analgetics are seldom indicated. Stool softeners are beneficial for easing defecation for the first post operative week. Hospital stay varies between 24 and 72 hours after vaginally conducted operations, depending on successful pain management. This is significantly longer after abdominal operation, as up to 7 post operative hospitalization days are frequently then required. Recommendations regarding post operative activity restrictions refer mainly to refraining from sexual intercourse which is strictly forbidden for 6 weeks, in order to prevent dyspareunia, suture breakdown and mesh exposure. Heavy lifting is usually advocated to be avoided as well as any other activities leading to increased intra-abdominal pressure and local pressure applied the operative field before complete tissue healing is achieved. Follow-up appointment is to be scheduled for the first and sixth post operative month and yearly thereafter. At these, post operative complications are to be looked for, including mesh exposure, granulation tissue formation, urine and feces storage and passage control impairments, sexual functions difficulties, vaginal or pelvic pain and various prolapse recurrence features.

### **PHVVP Mesh Reconstruction-further Post-operative Therapy**

Patient's QoL after operation might be improved with some simple adjuvant therapeutic measures, as stool bulking and softening agents, easing possible troubling defecation. Bladder over activity symptoms, such as urinary urgency, frequency and urge incontinence, either pre-operatively existing or de novo

appearing since, should be considered to be dealt with by anti cholinergic medications. Local or systemic estrogens could nicely reduce vulvo-vaginal inching and dyspareunia, be improving surface tissue atrophy. Physiotherapy for pelvic floor muscles reinforcement might often contribute to improving patient's QoL regarding pelvic floor functions re-establishment.

### **PHVVP Mesh Reconstruction-surgical and Clinical Available Data**

Reviewing the English written literature for high level evidence concerning POP surgery reveals some important conclusions: The no-mesh operations anatomical and functional long-term outcomes in terms of cure and complications are not well reported. This is true for vaginal hysterectomy for the cure of procidentia, for paravaginal and site specific prolapse repair, and for abdominal sacral colpopexy as well. Nevertheless, vaginal sacrospinial fixation and abdominal sacrocolpopexy have remained the "gold-standard" for repair of vaginal apical suspension defects. Being less invasive, the vaginal approach is safer and is associated with fewer side effects, yet shorter lasting than the abdominal for the surgical cure of PHVVP repair. Similarly, the use of mesh was found to be justified in terms of post operative prolapse recurrence and surgery related complications only for anterior pelvic floor reconstruction. Questions regarding the preferred mesh type, mesh for central and posterior pelvic floor compartment reinforcement and conservation of the prolapsed uterus remained improperly addressed and unanswered for the time being. As the relevant data referring the various mesh armamentarium is rather poor yet, the decision which mesh is to used- if at all, depends heavily on individual surgeon's training and experience. This is obviously insufficient for properly supporting this decision, which should a clearly evidence based decision making process.<sup>69-79</sup>

### **PHVVP Mesh Reconstruction-accepted Recommendations**

A Cochrane review, analyzing 22 trials, including 2368 patients, show that abdominal sacro-colpopexy (SCP) yields lower rates for POP recurrence and dyspareunia when compared with vaginal colpo-sacro-spineous fixation (VCSF). On the other hand, the VCSF is shorter in terms of operation time and recovery period. Mesh implants were found to reduce prolapse recurrence at the anterior vaginal wall reconstruction, and the vaginal approach was found to be superior to the trans anal for posterior compartment repair. Many other authors acknowledged the fact that the evidence available is not significant to guide practice and the relative shortage of relevant data needed for proper decision making regarding the operation choice for POP cure, including

PHVVP. At the same time is recognized an unacceptable high rate of recurrence with the non-mesh POP reconstructive surgery. Thus, it is widely agreed that meshes implantation should be further investigated prior to withdrawal of solid recommendations regarding their usage. Simultaneously, despite relative lack of evidence-based information regarding long term efficacy and safety, is the use of grafts for POP vaginal reconstruction growing rapidly. The mesh implantation must be considered carefully for each potential candidate, taking into account that the ultimate goal is QoL improvement, by correcting both, the anatomical and functional derangements. For the time being there are not any data-based guidelines recommendation for proper patient and surgery selection, peri-operative management and surgeon's training. There is a considerable debate regarding the performance of vaginal hysterectomy in association with POP surgery, whether is it beneficial or is it negatively influence the POP management.<sup>80-85</sup>

### PHVVP Mesh Reconstruction-surgeon's Proper Training

The preferred potential trainee for acquiring POP surgery skills must be expected to perform more than 20 operations with any specific POP type operation yearly, otherwise skill maintenance would not be feasible. Preliminary requirements are thorough theoretical knowledge regarding general pelvic floor medicine and familiarity with advanced pelvic floor surgery. The candidate training should be done with a very experienced trainer, and should include 20 operations of any type of surgery, to overcome the requested learning curve. Thorough knowledge and awareness concerning complications, including prevention, diagnosis and management is essential.<sup>83,85</sup>

### ETHICS

**Peer-review:** Externally peer-reviewed.

### DISCLOSURES

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