Vaginal Reconstruction/Rejuvenation: Is There Data to Support Improved Sexual Function? An Update and Review of the Literature

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ABSTRACT

"Vaginal rejuvenation" is a term that is commonly utilized to describe surgical repair of the vaginal canal and introitus following childbirth and/or aging to treat sexual dysfunction related to vaginal relaxation. It is well known that vaginal prolapse may lead to sexual dysfunction and in many studies repair of prolapse improves this dysfunction. During the progression of prolapse, sexual dysfunction or decreased vaginal sensation due to vaginal wall laxity may be one of the early symptoms that women suffer prior to the prolapse itself becoming symptomatic. Surgical repair or reconstruction of this type of vaginal defect may be indicated if repair will improve symptoms of sexual dysfunction caused by vaginal wall laxity. In this review, we will examine the existing data and make conclusions regarding vaginal rejuvenation and its impact on female sexual function.

Core tip: This is the first review of vaginal rejuvenation that shows improvement of sexual function. In this review, we covered the topic of relaxed vagina and sexual function, prolapse repair and sexual function, vaginal rejuvenation surgical techniques, and data to support vaginal rejuvenation techniques.

INTRODUCTION

Vaginal rejuvenation is a relatively new term that refers to repair of the vaginal canal and opening of the vagina for enhancement of sexual function. The concept may be referred to as "vaginal rejuvenation", "aesthetic vaginal surgery", "vaginoplasty", "vaginal tightening", or "cosmetic vaginal surgery". The term vaginal rejuvenation has recently created quite a controversy in the field of gynecology and urogynecology as well as in the public eye. There seems to be misinformation and confusion over what the term actually refers to, what procedures are actually being done, and where on the body they are completed. Some of these terms refer to cosmetic external surgery of the vagina and vulva (i.e., labiaplasty) or hymen restoration procedures. Other terms refer to surgery to enhance sexual function. In this review, "vaginal rejuvenation" is used to refer to surgical procedures of the internal vagina and the introitus that are designed to repair vaginal relaxation and to enhance or improve sexual function and sensation of the female vagina and reserve the term "cosmetic vaginal surgery" to refer to the outside of the vagina.

Vaginal rejuvenation has also been defined to include perineoplasty and vaginoplasty, which are techniques to "tighten" the vaginal canal and to elevate and strengthen the perineal body.[1] The purpose of these procedures is not to correct pelvic floor defects, but are modifications of traditional colporrhaphy and are frequently performed concomitantantly with reconstructive procedures for pelvic organ prolapse. These procedures involve vaginal reconstructive techniques to anatomically modify the vaginal caliber by decreasing the diameter of the vaginal canal while reconstructing the perineal body.[2-4] Utilizing this definition, one realizes that this is not a new field at all, that is, gynecologists have been dealing with sexual dysfunction related to vaginal pathology resulting mostly from vaginal childbirth for hundreds of years. However, the implication of this definition is to actually give credence to women's complaints of altered sexual function secondary to vaginal relaxation/looseness (Fig. 1) and possibly to do vaginal repairs prior to developing signs or symptoms of true prolapse or incontinence. As will be discussed later, many women who are candidates for vaginal rejuvenation in fact have symptoms and clinical findings of prolapse. Therefore, a proper repair must involve restoring the foundation of pelvic floor support and encompass some of the newer concepts of vaginal rejuvenation in the repair.

Prolapse and vaginal relaxation occurring after vaginal childbirth is not a new concept. We have clear evidence that vaginal delivery increases risks for vaginal support problems, vaginal relaxation, prolapse, and incontinence. Various pathophysiologic studies have demonstrated marked changes after vaginal delivery to levator muscles,[5,6] nerves,[7] and pelvic support.[8] It is obvious that parous women are more likely to have pelvic organ prolapse, fecal incontinence, and urinary incontinence than women who have not borne children.[9] There is ample epidemiological evidence that vaginal delivery appears to be the strongest risk factor for pelvic floor disorders.[10] As evident in the Women's Health Initiative,[11] women who had borne at least one child were twice as likely to have uterine prolapse, rectocele, and cystocele as nulliparas, after adjusting for age, ethnicity, body mass index, and other factors. The amount of damage at the time of vaginal childbirth has also been shown to be strongly correlated with sexual function. At six months postpartum, women with an intact perineum or first-degree perineal tear were less likely to experience sexual dysfunction than those with higher degree of perineal tear.[12,13] Interestingly, 80.4% of urogynecologists stated that they would agree to perform elective primary caesarian section at time of delivery.[14]

PROLAPSE AND SEXUAL FUNCTION

Female sexual dysfunction is defined as a disorder of sexual desire, arousal, orgasm, and/or sexual pain, contributing to personal distress.[15] Sexual dysfunction is a multifactorial disorder; biological, psychosocial, and relational factors can contribute to female sexual dysfunction. Among these factors, the pelvic floor appears to have an important influence. Dysfunction of vaginal support leading to incontinence, prolapse and sexual dysfunction is highly prevalent.[16] Surprisingly, little research has been undertaken regarding the sexual function part of pelvic floor disorders. One would not argue that surgery to correct pelvic organ prolapse or incontinence is justified. The American Urogynecologic Society has stated that any surgery for pelvic organ support should take into account to restore the normal anatomy and function of the pelvic floor and vagina, including to maintain support, and also maintaining or correcting bowel, bladder, and sexual function. Despite these goals, very little

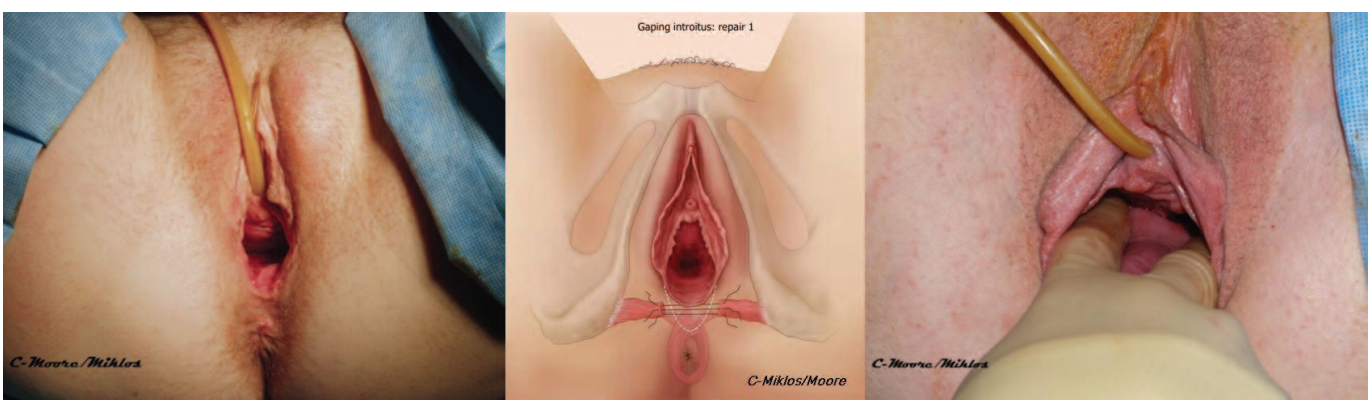

Figure 1. Damaged perineal body, relaxed introitus, and vaginal canal.

Table I
Pelvic organ prolapse (POP) effects on sexual function

Author, year	Study design	N	Objective	Population	Sexual function measurement	Results
Ellerkmann et al., 2001[26]	Prospective observational study	237	To compare the symptoms that are related to pelvic floor dysfunction with the location and severity of the coexisting prolapse	Patients with symptomatic pelvic organ prolapse came to Johns Hopkins Medicine	The Pelvic Floor Dysfunction Questionnaire	Increasing severity of POP is associated with sexual dysfunction
Barber et al., 2002[24]	Multi-armed clinical trial	343	To compare sexual function in women with urinary incontinence and pelvic organ prolapse	343 community-dwelling women older than 45 years with urinary incontinence or advanced prolapse	The condition-specific sexual function questionnaire	33.3% POP group felt that prolapsed or urine leakage affected their ability to have sexual relations compared with 10% of urinary incontinence group (p=0.02)
Novi et al., 2005[22]	Unmatched case-control	60	To compare sexual function in women with vs. without POP	30 women with pelvic organ prolapse compared with 30 unmatched controls without evidence of prolapse	PISQ	Pelvic organ prolapse appears to have a significant negative impact on sexual function compared with control (81.4 ± 7.3 vs. 106.4 ± 15.5, p <0.001)
Botros et al., 2006[23]	Identical twin study	542	To assess the impact of childbirth on sexual function	276 identical, sexually active twins	PISQ-12	Nulliparous women reported superior sexual satisfaction scores compared with parous women, regardless of age and mode of delivery (102.5 vs. 93.5, p < .001)
Srikrishna et al., 2008[27]	Prospective observational study	43	To evaluate the expectations and goals of women undergoing surgery for POP	Women with symptomatic POP were recruited from the waiting list for pelvic floor reconstructive surgery	The prolapse quality-of-life (pQoL) questionnaire	20% women were dissatisfied with their sex lives as a result of their prolapse.

information regarding sexual function and vaginal relaxation exists in the literature. In the landmark textbooks by leaders in the field of urogynecology, there are no chapters at all regarding sexual function and prolapse[17-19] and very little or no reference is made to it throughout the texts.[20]

Therefore, the question needs to be answered: 1) does prolapse and/or vaginal relaxation cause sexual dysfunction? 2) Does repair improve sexual function and/or sensation of the female vagina? While there is lacking data, we will examine the existing data and make some educated conclusions regarding vaginal relaxation and sexual function. Finally, we will address whether repair of vaginal relaxation, which may not be severe enough to cause symptomatic prolapse, results in an improvement of sexual function. The Pelvic Organ Prolapse/Incontinence Sexual Questionnaire (PISQ) and the Female Sexual Function Index (FSFI), among other tools, are validated questionnaires on sexual function and are necessary tools to measure sexual function.[21]

PROLAPSE REPAIR AND SEXUAL FUNCTION

Repairs of the pelvic floor and vaginal support have been completed for many years and one of the goals of any defect repair is to restore or maintain sexual function. Therefore, the assumption is that that prolapse affects sexual function in a negative way. Many studies support this theory as well (Table I). Novi et al. compared sexual function in women with and without prolapse using PISQ.[22] They found that prolapse had a

significant negative impact on sexual function, when compared to the group without prolapse. The study also reports that the PISQ scores were not significantly different between patients who had pelvic surgery to correct prolapse in the past and patients who never had prolapse. This may indicate that the surgical repair of prolapse improved their sexual function scores. Botros et al. studied the impact of childbirth on female sexual function using an identical twin study design.[23] The PISQ was administered to 276 identical, sexually active twins to examine their sexual function. The analysis showed that nulliparous women reported superior sexual satisfaction scores compared to parous women. Barber et al. evaluated sexual function in women with urinary incontinence and pelvic organ prolapse and reported that prolapse was more likely than incontinence to affect sexual activity and sexual relations.[24] Rogers et al. also reported that women with urinary incontinence and/or pelvic organ prolapse, when compared to women without this condition, had significantly poorer sexual function on the PISQ score and reported less sexual activity.[25] In addition, impairment of sexual relations and duration of abstinence were strongly associated with worsening pelvic organ prolapse.[26] These studies have confirmed that prolapse, albeit a more severe form of vaginal relaxation, but certainly relaxation, can contribute to sexual dysfunction.

Cardozo et al. also evaluated whether prolapse may impact sexual function and found that 83.6% of women presenting for prolapse surgery list improved sexual function as part of their goal for surgery.[27] This clearly indicated that women with prolapse are stating the prolapse affected their sexual function and improving sexual function is a goal of their prolapse repair. They also found a significant improvement in sexual function after the prolapse repair was completed (Table II). These findings were also recently confirmed by Rogers et al. in a multicenter prospective study evaluating sexual function after surgery for prolapse and/or incontinence with improved sexual function scores after repair.[28]

We feel that the posterior vaginal wall anatomically controls most of the vaginal caliber secondary to its relationship to the levator ani and genital hiatus and repair of this wall is a major portion of most rejuvenation type procedures. Therefore, studies evaluating rectocele repairs may have more of a direct correlation to vaginal caliber and sexual function. Bradner et al. reported that posterior repair had a positive impact on sexual function. They examined FSFI score before and after surgical rectocele repair in sexually active patients who had symptomatic rectoceles. There were significant improvements of FSFI score in domains of sexual desire, satisfaction, and pain.[35] Tunuguntia and Gousse found that while posterior repair with levatorplasty leads to sexual dysfunction and pain in many women, that actually posterior colporrhaphy completed alone, with the avoidance of levator ani plication, improves sexual function.[41] Komesu et al. investigated the effect of posterior repair on sexual function by using PISQ score. They included a cohort of patients who underwent pelvic floor reconstructive surgery with and without posterior repair and found that both groups significantly improved in sexual function.[32] Paraiso et al. compared three different methods of posterior rectocele repair including one that utilized a graft and reported that all three approaches resulted in statistically significant improvements in the PISQ score.[30]

Prolapse repair not only improves female sexual function, but also improves male sexual function. Kuhn et al. evaluated sexual function in female patients and their male partners by using FSFI for female patients and Brief Male Sexual Inventory (BMSI) for their partners. FSFI scores in women improved significantly in the domains desire, arousal, lubrication, overall satisfaction, and pain. For their partners, there was significant improvement in sexual drive and overall satisfaction. However, erection, ejaculatory function, and orgasm remained unchanged.[34]

VAGINAL RELAXATION AND EFFECT ON SEXUAL FUNCTION AND SENSATION

It is clear by the above data that prolapse has a role with creating sexual dysfunction. The difficulty with this is that sexual function is multifactorial and can, because of this, be a very difficult area to study. It is also clear from the above studies that vaginal repair improves sexual function and sexual quality of life, but is it because of the prolapse creating discomfort causing the woman to avoid intercourse or because of self-image issues regarding the prolapse? Or is it because vaginal relaxation and prolapse may cause decreased sensation leading to sexual dysfunction, that is, feeling less, having a harder time achieving orgasm or feeling self-conscious about the fact that she feels her vagina is loose, stretched out, or relaxed? Again, a very difficult issue to study and to date the literature is lacking in this regard.[42] We can, however, take a look at some basic anatomy and function of the vagina in its relation to sensation, orgasm, and sexual function and come up with very educated conclusions by putting together the available data in regards to anatomy, function, as well as considering the above data showing that repair of vaginal prolapse improves sexual function.

Ozel et al. recently published one of the first reports evaluating libido, sexual excitement, vaginal sensation, and ability to orgasm in a group of women with prolapse compared to women without prolapse. They found that women with prolapse and vaginal relaxation were significantly more likely to report an absence of libido, lack of sexual excitement during intercourse, and a much lower frequency of achieving orgasm during intercourse (all statistically significant) compared to women with the same demographics without prolapse (i.e., multiparous, similar age, marital status, etc.).[43] This is a landmark study as it is one of the first studies evaluating the sensation of the vagina and the changes it may go through following relaxation of the tissues that cause prolapse.

The reasons why vaginal relaxation or prolapse may affect sensation are multifactorial and difficult to ascertain. It has been shown that when voluntarily contracted, the pelvic floor muscles can intensify orgasms for women.[44] Decreased sensation and difficulty achieving orgasm may be secondary to nerve damage from childbirth, muscular changes, and soft tissue changes. And, to date, we have no way of studying or confirming the exact cause prior to surgery. We can assume however, that if most women with prolapse have improved sexual function following repair, that even in this more extreme

Table II
POP repair improved sexual function studies

Author, year	Study design	N	Objective	Population	Sexual function measurement	Results
Barber et al., 2002[24]	Multi-armed clinical trial	343	To compare sexual function in women with urinary incontinence and pelvic organ prolapse	343 community-dwelling women older than 45 years with urinary incontinence or advanced prolapse	The condition-specific sexual function questionnaire	Fewer patients with POP reported that their prolapse affected their ability to have sexual relations 6 months after vaginal reconstructive surgery than at baseline (0% vs. 33%, p<0.01).
Roger et al., 2006[28]	Prospective observational	67	To compare sexual function in women with POP before and after vaginal reconstructive surgery	Women who underwent vaginal reconstructive surgery	The urogenital distress inventory and incontinence impact questionnaire revisited	There was a significant improvement of dyspareunia after surgery. The ability to have intercourse, the satisfaction and the frequency of intercourse improved although not significantly.
Paraiso et al., 2006[30]	Randomized controlled trial	106	To compare outcomes of 3 different rectocele repair techniques (posterior colporrhaphy, site-specific rectocele repair, or site-specific rectocele repair augmented with a porcine small intestinal submucosa graft)	Patients undergoing surgery for stage II or greater posterior vaginal wall prolapse	PISQ-12	PISQ-12 improved significantly in all groups postoperatively (P <0 .001), with no differences between groups.
Handa et al., 2007[31]	The CARE trial	224	To describe sexual function before and after sacrocolpopexy	Stress-continent women planning abdominal sacrocolpopexy for stage II-IV prolapse	PISQ-12	Among women who were sexually active before and after surgery, the mean PISQ-12 score improved significantly (34.1 ± 5.2, P < .001).
Komesu et al., 2007[32]	Multicenter prospective cohort	73	To determine the effect of posterior repair (PR)on sexual function in patients who have undergone incontinence and/or pelvic reconstructive surgery	Sexually active patients who had undergone pelvic reconstructive and/or incontinence procedures	PISQ	Significantly improved their PISQ scores in both PR and non-PR groups, without a difference between groups.

situation causing true symptomatic prolapse, that any associated nerve damage that may exist is overcome by the repair of the prolapse and returning the vagina back to its normal anatomic state. It also just makes logical sense that vaginal caliber can affect vaginal sensation. This has been studied and it has been shown that vaginal tone affects vaginal sensation and the ability to orgasm.[45] Tone is comprised of two variables, both levator muscle tone and the elasticity of the vaginal tissues attached to the muscles. Kline utilized a perineometer to evaluate vaginal tone and control (woman's ability to create a sustained contraction and create vaginal tone) and showed that women with decreased tone or

Table II (continued)
POP repair improved sexual function studies

Author, year	Study design	N	Objective	Population	Sexual function measurement	Results
Azar et al., 2008[33]	Prospective observational	60	To evaluate the effect of surgical repair of POP on female sexual function	Women with POP	FSFI	Sexual function was improved 12-16 weeks postoperatively (15.9±10.7 vs. 21.9±11.1, p<0.05)
Kuhn et al., 2009[34]	Prospective observational	70 female 64 male	To determine the male and female sexual function before and 4 months after surgery for POP	Sexually active heterosexual couples with symptomatic cystocele, rectocele or vault descent.	FSFI	In women, FSFI scores improved significantly in the domains desire, arousal, lubrication, overall satisfaction, and pain. In men, sexual drive, and overall satisfaction improved significantly.
Brandner et al., 2011[35]	Prospective observational	68	To evaluate sexual function before and after surgical rectocele fascial repair in sexually active patients who suffer from symptomatic rectoceles	Sexually active female patients who were to undergo rectocele fascial repair for symptomatic rectoceles	FSFI	Significant improvement for desire (P<0.001), satisfaction (P<0.0001), and pain (P<0.0001).
Lakeman et al., 2013[36]	Prospective observational	29	To evaluate the effects of vaginal prolapse surgery on vaginal vasocongestion, vaginal wall sensibility, and sexual function	Patients scheduled for vaginal prolapse surgery	FSFI	Improvement of sexual function after prolapsed surgery (20.5 vs. 23.3, p=0.30)
Thibult et al., 2013[37]	Multi-center prospective	148	To evaluate the impact of laparoscopic sacrocolpopexy on symptoms, health-related quality of life (HRQL) and sexuality among women with symptomatic urogenital prolapse (UGP)	Patients with symptomatic POP who are undergoing laparoscopic sacrocolpopexy	PISQ-12	Postoperative sexual function had improved significantly (35.42 vs. 32.07, P < 0.05)

levator atrophy had a more difficult time reaching coital orgasm and, if reversed, the women's ability to achieve coital orgasm returned. Some argue that Kegel exercises alone can achieve this in a patient with decreased vaginal tone, and this certainly can be true in patients with true levator atrophy. However, in women that the vaginal walls and its inherent endopelvic fascia are stretched out beyond their elastic capability to recover or not attached to the levators at all, the levators, no matter how strong, cannot overcome this and create a taught vaginal canal, and this will affect vaginal sensation.

We have shown so far in the review that vaginal prolapse can definitely affect sexual function and its repair can improve sexual function and ability to orgasm. The question though, is how much vaginal relaxation does a woman need to have to have decreased sensation or sexual dysfunction? And, if women do have a sense of a relaxed or loose vagina that is causing them to have sexual dysfunction prior to them having

Table II (continued)
POP repair improved sexual function studies

Author, year	Study design	N	Objective	Population	Sexual function measurement	Results
Kim et al., 2014[38]	Prospective observational	143	To evaluate the effect of surgical repair of POP on female sexual function	Patients scheduled to undergo surgery for POP stage II-IV	FSFI, PISQ-12	Improvement of PISQ score from 25.0±4.95 to 28.33±5.1 postoperatively (p<0.001) No differences of pre and post-op FSFI (p=0.08), however only the satisfaction domain score significantly increased (p=0.029).
Salamon et al., 2014[39]	Randomized controlled trial	81	To compare sexual function before and 1 year after laparoscopic sacrocolpopexy using a porcine dermis or a polypropylene mesh material	Patients scheduled for laparoscopic sacrocolpopexy were randomly assigned to undergo a LSC using a porcine dermis derived implant of cross-linked acellular collagen mesh (Pelvisoft; CR BARD, Inc, Murray Hill, NJ) or a type 1 polypropylene mesh (Pelvitex; CR BARD, Inc).	PISQ-12	Significant postoperative improvement in total PISQ-12 scores for the entire cohort (33.2 vs. 38.3, P < 0.01) and both groups No differences between the 2 graft material groups
Kim-Fine et al., 2014[40]	Prospective observational	41	To describe changes in sexual function between the initial (6 weeks to 6 months) and the medium-term (18–36 months) postoperative periods after vaginal surgery.	Patients undergoing vaginal hysterectomy for benign indications and patients with symptomatic POP who opted for a native-tissue vaginal approach for prolapse repair	PISQ-12	No significant change in PISQ-12 between initial and medium-term postoperative periods after vaginal reconstructive surgery (34.1 ± 6.0 vs. 32.9 ± 6.0; P = 0.19)

any of the traditionally described symptoms of prolapse (i.e., feeling or seeing a bulge, incontinence, voiding dysfunction or bowel dysfunction), will a repair of the caliber of the vagina reverse these changes and improve sexual function? In the past, we turned these patients away because their only symptom was sexual dysfunction and they did not have true prolapse and therefore did not have indication for surgical repair. We were ignoring one of the major aspects of quality of life in a couple's relationship, which is sexual function. This is what vaginal rejuvenation is all about, completing a vaginal repair of a relaxed vaginal opening and vaginal canal for sexual function and the woman's subjective symptoms of feeling as if her vagina is loose and/or wide open.

VAGINAL REJUVENATION—SURGICAL TECHNIQUES

Importance of Proper Evaluation and Diagnosis

Proper pre-operative evaluation is a vital process for a patient that presents with an interest in surgery to repair what she conceives is a loose or relaxed vagina and would like it tightened for sexual enhancement or to correct the feeling of having a "wide-open" vagina (i.e., vaginal rejuvenation surgery). This includes proper medical history and psychosocial evaluation for sexual dysfunction and or sexual satisfaction prior to any of the anatomical changes she may have noted since childbirth. Marital or relationship issues or concerns and an evaluation of her expectations of surgery and the reasoning why she is interested in the procedure should be discussed as well. It is true that most women that present to our clinic had a very satisfactory sexual life and then experienced a major change subsequent to their pregnancies and deliveries or gradually by aging. However, sexual dysfunction is very complex and multifactorial and of course a surgical procedure to repair vaginal support and reduce the vaginal caliber will not reverse or change psychologic or psychosocial sexual dysfunction arising from previous abuse, primary anorgasmia, relationship issues, depression, or other more complex psychologic dysfunction.

Of course, in addition to a medical and psychosocial history, an adequate urogynecology history and physical exam must be completed. Sexual dysfunction related to a sense of a relaxed or loose vagina may be the first sign of the beginning stages of pelvic floor dysfunction and prolapse; therefore, an adequate history must be taken. We have actually found that as many as 50 to 75% of patients that present for vaginal rejuvenation, when asked, have symptoms including urinary incontinence, voiding dysfunction such as overactive bladder or difficult emptying, feelings of pressure or the sense that their organs are falling, defecatory dysfunction, or dyspareunia related to the uterus being hit during intercourse because of prolapse. It is vitally important to have an adequate understanding of the symptoms that prolapse can cause, and we use validated questionnaires such as the UDI-6, IIQ-7, and the PISQ-IR[46] to evaluate patients for these symptoms as well as a general urogynecologic history form. If significant symptoms of urogynecologic pathology are present, this must be evaluated preoperatively so that it can be addressed properly during surgery. Any prolapse that is present must be repaired properly at time of surgery including uterine/vault prolapse, enterocele, cystocele, or rectocele as vaginal rejuvenation procedures do not adequately treat these defects. The foundation of the pelvic floor support must be intact prior to any technique that will tighten the caliber of the vagina or introitus.

SURGICAL PROCEDURES

The surgical procedure required is determined by the patient's physical exam. Again, many women that present interested in vaginal rejuvenation type surgery, or surgery to correct a feeling of a loose or wide vagina, are found to have prolapse in the form of cystocele, rectocele, or uterine/vault prolapse. In most instances, it is POP-Q Stage II or less; however, it is present and must be repaired. This is what determines what surgery will need to be done as the prolapse must be corrected first, prior to any rejuvenation procedures being completed and is really the first step in an overall repair or "rejuvenation" of the vagina and pelvic floor. If significant uterine/vault prolapse and/or anterior compartment (cystocele) defects are encountered, these typically should be repaired abdominally/laparoscopically/robotically prior to addressing the posterior compartment and the caliber of the vagina.

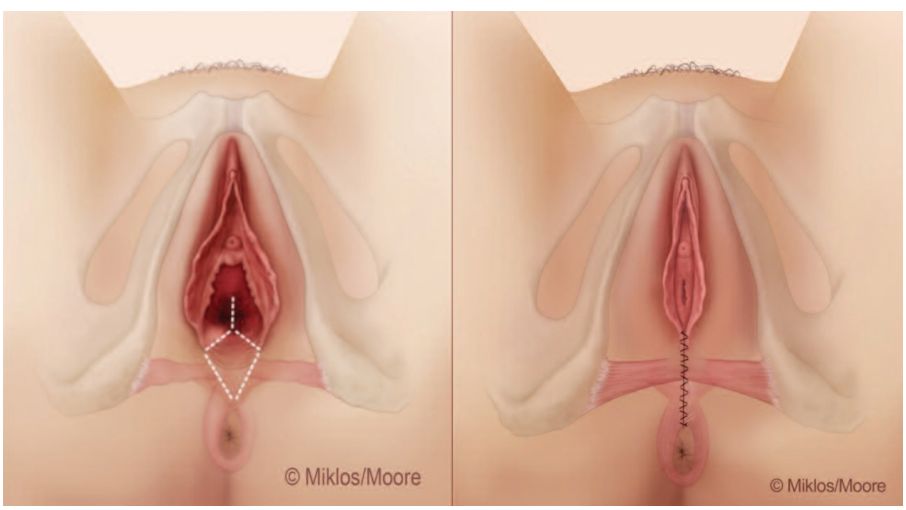

Figure 2. Incision and after vaginal rejuvenation procedure.

REJUVENATION OF THE VAGINAL CANAL AND INTROITUS

Repair of the posterior vaginal wall and the introitus are the key aspects to any vaginal rejuvenation procedure. Vaginal rejuvenation surgeries are alterations and modifications of vaginal repairs for prolapse that focus on the final diameter and caliber of the vagina and attempt to restore it back to its pre-childbirth state. They however do go far beyond the simple traditional posterior repairs and perineoplasty of old. The focus of these older procedures is simply to restore and reduce the bulge, whereas the focus of vaginal rejuvenation is to restore the caliber of the vagina and genital hiatus back to pre-childbirth state from the introitus all the way up to the apex. They are much more extensive and meticulous procedures. No drop-offs or dips should be felt and there should be no tension placed on the levators that causes lateral banding of the vagina. Additionally, the cosmetic appearance of the introitus and perineal body is also taken into account and requires an intricate dissection and repair to not only restore function of the introitus, but to also obtain an appearance that the woman is desirous of. That look is of the vaginal opening being closed, not gaping or wide open with a normal length perineal body that does not bulge out following the repair. This look is

sometimes difficult to obtain, without making the introitus too tight, which will cause pain with intercourse.

POSTERIOR WALL, INTROITUS, AND REJUVENATION

The posterior vaginal wall is the focus of any vaginal rejuvenation procedure. In a woman with a mild cystocele or mild relaxation of the anterior vaginal wall, a small anterior colporhaphy can be completed to take care of this prior to repair of the posterior wall. However, one needs to be very careful with this because if the repair of the anterior wall is too aggressive, it will lead to lateral banding and constriction of the vagina, before the posterior wall is even started.

An incision is made at the introitus, typically in a trapezoid pattern that will also be used in the perineoplasty portion of the procedure (Fig. 2). A small incision is then made in a vertical fashion on the posterior wall and the vaginal epithelium is dissected off the underlying rectovaginal fascia all the way laterally out to the levators. The dissection must be taken all the way up to the apex of the vagina as the repair needs to incorporate the entire posterior wall to restore the caliber of the full length of the vagina. The dissection of the vaginal epithelium may be completed with a laser, or completed utilizing more standard techniques with sharp scissors or electro cautery. Care of course needs to be taken with any electrical energy source near the rectum. If a rectocele is present, the fascia is repaired in a site-specific fashion with delayed absorbable suture for the first layer of the repair. This may be a lateral repair of the defects, a midline plication, or a combination. The caliber of the vagina is then addressed by plication of the rectovaginal fascia in the midline with delayed absorbable sutures. Levator plication is avoided, however the diameter of the vagina is constantly measured and several layers of plication may be needed to reduce the genital hiatus and reduce the caliber of the vagina to an appropriate level. A small amount of vaginal epithelium is then excised and the incision closed in a running fashion.

A perineoplasty is then completed, involving a very meticulous and detailed dissection out laterally to obtain the lacerated edges of the deep and superficial transverse perineal muscles and bringing them back together in the midline to achieve uniformity at the same level of the posterior wall repair. The inferior edges of the labia majora, that will make up the posterior forchette of the vaginal opening, must be marked at the beginning of the procedure so that these edges match up during the closure to form the vaginal opening. An appropriate amount of skin must also be excised from the perineum and introitus to result in a cosmetically pleasing appearance of the opening of the vagina for the patient. A multilayer, (typically this may involve four or five layers) is completed at the perineum and introitus.

When a repair is primarily for repair of vaginal relaxation for sexual function, it becomes a much more meticulous dissection and repair as the surgeon has to constantly be judging and measuring vaginal caliber to try to restore the entire vaginal length to its pre-childbirth state. If this is not done, then the results will be poor and the patient's sexual function may not change or they will be worse secondary to pain, vaginal shortening, scar tissue formation, and/or constrictions.

DATA TO SUPPORT VAGINAL REJUVENATION TECHNIQUES (TABLE III)

The theory that vaginal size is related to sexual sensation has been studied by Pardo et al. on a group of women who presented with symptoms of a wide or relaxed vagina and were interested in vaginal repair for sexual function alone. The women had no symptoms of prolapse or incontinence. Inclusion criteria included a sensation of a wide or loose vagina alone in combination with a decrease or lack of ability to reach orgasm. Exclusion criteria included symptomatic prolapse (cystocele, rectocele, or vault/uterine prolapse), dyspareunia, primary anorgasmia, psychologic impairment (all patients had a psychological evaluation pre-operatively), or partner sexual dysfunction. Fifty-three patients were included in the study and 96% of the patients experienced decreased vaginal sensation, 73% described difficulty achieving orgasm, and 27% could not reach orgasm prior to surgery. All but two patients had previous vaginal deliveries. Following surgical repair of the vaginal caliber and tightening of the vagina (colpoperineoplasty using Yag laser for dissection), 90% of women reported their sexual satisfaction was much or sufficiently improved and 94% of women were able to reach orgasm. No patient reported worsened sexual function, however 4% of patients reported regretting undergoing the procedure.[2] In a follow-up study, they confirmed their findings in a second group of patients as well.[47] This confirmed that vaginal size has a direct impact on sensation and ability to orgasm and when repaired sexual function improves.

Matlock and Simopoulos conducted a study to evaluate sexual function in women presenting with subjective symptoms of vaginal relaxation with or without stress urinary incontinence following laser vaginal rejuvenation using PISQ score. Ninety-six patients underwent the procedure completed PISQ before and six months after surgery. All patients presented with chief complaint of relaxed vagina. Of those, 65% had stage II POP-Q. This finding suggests that early pelvic organ prolapse may manifest as vaginal relaxation. The overall sexual function improved after surgery. There were only 13% of women with a decreased PISQ score postoperatively. In addition, 53% reported increased intensity of orgasm during sexual intercourse.[48]

Goodman et al. led a recent multicenter US study on women undergoing female genital plastic surgery including vaginoplasty/perineoplasty for vaginal relaxation affecting sexual function. This study gathered data from diverse practices and surgical specialties with surgeons who utilize more than a single technique to achieve their desired outcome. Pre-operatively, 70% of women reported their sexual function was fair/poor. Postoperatively, it was found that 86% of 81 women following vaginoplasty/perineoplasty for sexual function reported enhanced sexual function following repair with only 1% reporting a negative effect on sexual function, confirming repair of the vaginal caliber may lead to improved sexual function in women presenting with relaxation. Eighty-three percent of women reported "satisfied" with the outcome of vaginal rejuvenation. The predominant reason for surgery from the physicians' and patients' prospective were feelings of looseness and lack of

Table III
Vaginal rejuvenation studies on female sexual function

Author, year	Study design	N	Objective	Population	Sexual function measurement	Results	Follow-up (month)	Complications
Pardo et al., 2006[30]	Prospective observational	53	Women with wide vagina and decrease or lack of ability to reach orgasm	Colpoperineoplasty (dissected with a Yag laser)	Patients' sexual activity, fulfillment of expectations, and vaginal width using a site-questionnaire	90% much or sufficiently improved of sexual satisfaction 94% tighter vagina, able to achieve orgasm 74% expectation fulfilled completely	1.5	4% regretted having procedures
Pardo et al., 2007[47]	Prospective observational	100	Women with wide vagina and decrease or lack of ability to reach orgasm	Colpoperineoplasty	Patients' sexual activity, fulfillment of expectations, and vaginal width using a site-questionnaire	95% tighter vagina during the intercourse 85% achieve vaginal orgasm 79% expectation fulfilled completely	4	4% regretted having the procedures 2 (0.02%) minor surgical complications
Adamo and Corvi, 2009[51]	Multicenter cross-sectional	258	Women undergoing female genital plastic surgery	Vaginoplasty/perineoplasty procedures (n=81)	Pre-operative sexual functioning per procedure, overall patient satisfaction per procedure, patient's perception of effect on her partner's sexual enjoyment, per procedure, complications	85% mild/significant enhanced sexual function 86% satisfaction Subjective improvement in sexual functioning for both women and their sexual partners (p = 0.008)	6-42	4% temporary stricture of vaginal apex 2% wound dehiscence 2% excessive postoperative pain 2% inadequate tightening 2% micro-tear at 1 year follow-up2% introital tightening 2% bleeding after first sexual intercourse 2% felt sutures inside vagina 2% introital narrowing
Goodman et al., 2010[49]	Multicenter cross-sectional	258	Women undergoing female genital plastic surgery	Vaginoplasty/perineoplasty procedures (n=81)	Pre-operative sexual functioning per procedure, overall patient satisfaction per procedure, patient's perception of effect on her partner's sexual enjoyment, per procedure, complications	85% mild/significant enhanced sexual function 86% satisfaction Subjective improvement in sexual functioning for both women and their sexual partners (p = 0.008)	6-42	4% temporary stricture of vaginal apex 2% wound dehiscence 2% excessive postoperative pain 2% inadequate tightening 2% micro-tear at 1 year follow-up 2% introital tightening 2% bleeding after first sexual intercourse 2% felt sutures inside vagina 2% introital narrowing

Table III (continued)
Vaginal rejuvenation studies on female sexual function

Author, year	Study design	N	Objective	Population	Sexual function measurement	Results	Follow-up (month)	Complications
Moore et al., 2014[52]	Prospective observational	78	Women presenting for vaginal rejuvenation/vaginoplasty procedure for a chief complaint of vaginal laxity and decreased vaginal sensation with intercourse	Vaginal rejuvenation	Comparing pre- and post-operative sexual function using PISQ-12 score	Mean PISQ-12 improvement from 30.3±6.6 to 38.2±5.2 (p<0.001)	>6	

coital friction and sexual pleasure[49]. A literature review by Goodman indicated that female genital plastic surgery procedures, including vaginal rejuvenation, appear to fulfill the majority of patient's desires for cosmetic and functional improvement, as well as enhancement of the sexual experience. The majority of patients reported improvement of overall satisfaction and subjective enhancement of sexual function and body image.[50]

Most recently, we evaluated sexual function outcomes in a group of women (n=78) presenting for vaginal rejuvenation/vaginoplasty procedure for a chief complaint of vaginal laxity and decreased sensation with intercourse.[52] Outcomes were analyzed utilizing the validated Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire-12 (PISQ-12) before and at least six months after repair with vaginal rejuvenation/vaginoplasty procedure (VR). Compared preoperatively and postoperatively, the overall sexual function (Total PISQ-12) statistically improved (30.3±6.6 vs. 38.2±5.2, P<0.001). All individual scores statistically improved except in three categories which there was no change (Q1-desire, Q5-pain and Q11- partner premature ejaculation). Overall, sexual satisfaction improved as well as sub-categories of increased sexual excitement during intercourse and overall increase in intensity of orgasms. Pain with intercourse sub-scores were found to be no different from preoperatively to postoperatively.

Our review carries the inherent limitation of relatively few currently published studies and nonrandomized controlled trials currently available in the literature to evaluate the role of vaginal rejuvenation on sexual function. Another limitation of this review is that there is a lack of comparative data in the literature evaluating improvement in sexual function with vaginal rejuvenation versus other procedures. This most likely is secondary to the fact it is a relatively new procedure for these indications and therefore not yet globally adopted and also limits the ability to do a meta-analysis.

CONCLUSION

Vaginal rejuvenation surgery is one of the latest trends in elective vaginal surgery for women. It is a repair of the vaginal caliber in women that suffer from decreased vaginal sensation or of feelings of a loose or wide vagina that affects their sexual life. In many instances, women that present with these symptoms are found to have other urogynecologic pathology such as prolapse that must also be addressed in any repair contemplated. Sexual dysfunction or decreased sexual sensation may be one of the first symptoms that women suffer from in the progression of prolapse and, therefore, a proper exam is vital prior to any repair. We have ample evidence, as seen presented in this review, that prolapse and vaginal relaxation can create sexual dysfunction and that repair may reverse these changes in many women. However, when dealing with sexual dysfunction alone and the caliber or width of the vagina, the surgical repair must be very meticulous and exact in order to enhance sensation and function and not impair it. This sums up the statement "The Art of Surgery"! STI

AUTHORS' DISCLOSURES

The authors have no conflicts of interest to disclose.

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