Brief Overview about Sacrospinous Ligament Fixation for the treatment of uterine and vaginal vault prolapse

Osama Elsayed Mohammed Elsayed, Mostafa Shafeek Mostafa, Abdulmagid Mahmoud Sarhan, Hussein Mohammed Abdeldayem

Department of Obstetrics and Gynecology, Faculty of Medicine, Zagazig University, Egypt

Corresponding author: Osama Elsayed Mohammed Elsayed

E-mail: muslimman2013@gmail.com, osamahussein@medicine.zu.edu.eg

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Abstract

Richter was the first to describe the sacrospinous colpopexy for the treatment of vaginal vault prolapse in 1968. Over the years, the procedure gained popularity thanks to the work of Randall and Nichols who introduced the procedure in the United States in 1971. The sacrospinous fixation has evolved from a procedure performed under direct vision with a standard needle requiring extensive dissection, into a blind procedure requiring less extensive dissection with the aid of suture delivery devices. Older instruments used in the technique include the Miya hook and Deschamp clamp. Newer instruments include suture delivery devices like the Caspari, Endostitch, i stitch and the Capio suturing device.

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Introduction:

Richter was the first to describe the sacrospinous colpopexy for the treatment of vaginal vault prolapse in 1968. Over the years, the procedure gained popularity thanks to the work of Randall and Nichols who introduced the procedure in the United States in 1971 **(Gutman,2020)**.

The sacrospinous fixation has evolved from a procedure performed under direct vision with a standard needle holder and cat gut sutures requiring extensive dissection, into a blind procedure requiring less extensive dissection with the aid of suture delivery devices. Older instruments used in the technique include the Miya hook and Deschamp clamp. Newer instruments include suture delivery devices like the Caspari, Endostitch, i stitch and the Capio suturing device **(Mowat et al., 2018)**.

Surgical anatomy

It is important to understand the anatomy of the sacrospinous ligament to avoid potential injury to the surrounding structures. The sacrospinous ligament is a strong pelvic ligament that extends as a fan shaped sheet from the ischial spine laterally to the lateral margins of the coccyx and the last piece of the sacrum medially. It separates the greater and lesser sciatic foramina (**Florian-Rodriguez et al., 2016)**

The sacrotuberous ligament lies posterior to the sacrospinous ligament with the **perineal branch of S4 nerve** runs between them. The sacrotuberous and sacrospinous ligaments hold the sacrum to the ischium thus supporting the posterior part of the sacrum **(Gutman,2020).**

The coccygeus muscle overlies the sacrospinous ligament and both have the same attachment sites thus they are both referred as the coccygeus-sacrospinous ligament (CSSL) complex. The CSSL can be identified by palpating the ischial spine and feeling the cordlike structure that passes medially and posteriorly toward the sacrum. **(Gutman,2020)**

The surrounding structures to The CSSL include important blood vessels and nerves that must be considered during surgery. **The pudendal nerve and vessels** run posterior to the ischial spine. **The inferior gluteal vessels, hypogastric venous plexus, and the sciatic nerve and its nerve roots** run above the ligament. **The sciatic nerve and gluteal vessels** pass laterally as they enter the greater sciatic foramen. **The nerves to the coccygeus and levator ani muscles** arise from sacral trunk and lie on the ventral surface of these muscles and could be injured when placing sacrospinous ligament fixation sutures **(Gutman,2020).**

A cadaveric study evaluated the proximity of these nerves and vessels to the sutures when they are placed using different suture-capturing devices. The average ligament length was 4.8 cm, and the two sutures were 2.0 cm and 2.5 cm from the ischial spine. The nerves to the coccygeus and levator ani muscles were the closest structures **(Katrikh et al., 2017).**

Placing the sutures in the middle third of the ligament reduces neurovascular injury. Placing sutures through the medial third of the ligament increase the risk of injury to S4 root and placing the sutures in the lateral third of the ligament where the pudendal nerve and vessels are located should be avoided. **(Katrikh et al., 2017)**

Indications

Vaginal vault prolapse can be corrected either via abdominal or vaginal techniques. Commonly used abdominal procedures include sacral colpopexy, and vaginal procedures include high uterosacral suspension and sacrospinous colpopexy. **(Mowat et al., 2018)**

Sacrospinous hysteropexy is one of the best studied uterine preservation prolapse surgeries. During this repair, the cervix or uterosacral ligaments are transfixed to the sacrospinous ligament with two or three nonabsorbable or delayed absorbable sutures. **(Wang et al., 2022).**

Prophylactic SSLF has been suggested at the time of vaginal hysterectomy for marked uterovaginal prolapse, when the vault (point C on the POP-Q system) could be pulled to the introitus at the end of anterior vaginal wall closure **(Cruikshank and Cox, 1990)**

Surgical steps

The sacrospinous fixation was originally described as a bilateral procedure, over the years, most studies favored the unilateral procedure due to shorter operative time and less operative morbidity. Usually, the right sacrospinous ligament is used for suspension as most surgeons are right-handed. **(Pohl and Frattarelli, 1997).** Unilateral fixation causes slight deviation of the vagina to the right which is insignificant and does not affect the Quality of life, subjective, or sexual outcomes **(Juliato et al., 2019).**

The Patient is positioned in standard lithotomy position, the anesthesia is administered, the vagina is surgically prepared, and a Foley catheter is inserted **(Corton M., 2020).**

The first and most important step is to first identify the planned vaginal apex. The apex of the vagina is grasped with two Allis clamps so the Extent of the prolapse can be assessed. The vagina is then reduced to the Sacrospinous ligament **(Corton M., 2020).**

The traditional approach to Sacrospinous ligament is through posterior colporrhaphy incision then dissection of the pararectal space and approaching the right Sacrospinous ligament. The less common apical approach include accessing the Sacrospinous ligament through an apical incision as described in the Michigan four-wall modification, this approach does not require perforation of the rectal pillars **(Larson et al., 2013)**

A posterior vaginal incision is made and extended to the vaginal Apex. The next step is entry into the rectovaginal space then pararectal space. These tissues are typically attenuated in women with advanced prolapse and thus easier to perforate. A window must be created through the rectal pillar, which is best accomplished by blunt dissection laterally toward the ischial removing the excess tissue over the CSSL spine. This dissection can also be accomplished using tips of scissors, a tonsil clamp, or a hemostat. The ischial spine is palpated, a finger is passed dorsal and medial to palpate the sacrospinous ligament. **(Gutman,2020)**

For an apical approach to the ligament, dissect and open the space between the vaginal cuff and peritoneum at 7 o'clock bluntly and sharply with Metzenbaum scissors. Then perform blunt finger dissection internally toward the right ischial spine and sacrospinous ligament, sweeping laterally to medially removing excess tissue. Widen the area to permit direct apposition of the vaginal cuff to the ligament. **(Gutman,2020)**

In the setting of concomitant vaginal hysterectomy. after removal of uterus, A vertical incision is made through the midline posterior vaginal wall at the open cuff and extended 2 to 3 cm distally. Then, the pararectal space is entered as described before. **(Corton, 2020)**

For an anterior approach, after an anterior vaginal incision is made, the paravesical space is entered laterally followed by the pararectal space. **(Gutman,2020)**

Once the ligament is identified, Breisky-Navratil Retractor is placed gently to displace the rectum medially to expose the CSSL complex allowing direct visualization. Raking the retractor over the Anterior surface of the sacrum should be avoided as it may cause injury to presacral nerves and vessels. The middle and index finger of the left hand are placed on the medial surface of the ischial spine. **(Gutman,2020)**

Direct visualization of the ligament is necessary when using the traditional suturing devices such as a Miya hook or Deschamps ligature carrier. Recently, suturing can be performed by suture-retrieving devices through palpation of the ligament without direct visualization **(Mowat et al., 2018)**.

Different Devices used in Sacrospinous Ligament Fixation

The original description of sacrospinous suture placement used a regular needle holder to place three catgut sutures in the ligament, starting 2 cm medial to ischial spine. this direct technique requires skill, wide dissection and good visualization and consequently excessive bleeding and possible rectal injury **(Morley and DeLancey, 1988).**

Over time, Suturing Devices were introduced to avoid excessive dissection and retractors placement that may cause excessive bleeding and rectal injury. **(Manning and Arnold, 2014).**

Recently, Suture retrieval devices were introduced to allow blind placement of sutures without direct visualization and thus avoiding dissection and minimizing the operative time and complications. These Suture retrieval devices confine sutures to the body of the ligament and prevent passing beyond the ligament which cause injury to pudendal vessels, Inferior gluteal Vessels, 4^{th} sacral root and coccygeal nerve **(Manning and Arnold, 2014).**

Miya hook

In 1987, Miyazaki introduced a specially designed ligature carrier (Miya hook). This is a reusable device with a sharp-hinged and distally fenestrated hook which takes any generic suture. Under clear direct vision, the tip perforates the ligament superiorly, then the hook closes, causing it to take a downward, tightly curved course, retreating out through the ligament. **(Miyazaki, 1987)**

Deschamps aneurysm needle

Its corkscrew shaped curved tip makes a tight 85° angle perpendicular with the shaft. It is 2 cm wide with a 160° turn. The fenestrated tip can be loaded with any generic suture and introduced under direct vision into the upper lateral aspect of the sacrospinous ligament and the Depth of penetration is operator dependent. Sutures are usually retrieved using nerve hook under direct vision. **(Manning and Arnold, 2014)**

i Stitch

At its tip, is a blunt, right-angled straight hook, 21 mm long and 10 mm deep. This has an eye to capture a single use, product-specific suture. The hook will penetrate perpendicularly into the ligament **(Manning and Arnold, 2014).**

Caspari suture punch

The working end comprises a single-hinged 10-mm-long, 2.5-mm-wide blunt hook for suture pickup. This reusable device manually loads with any operator-desired suture and presents it to the hook **(Manning and Arnold, 2014).**

Endostitch

The tip has two large-hinged, 2-cm-long, 4-mm-wide, blunt jaws which open and close perpendicular to the ligament. They impress the surface of the ligament without perforating it, A reusable product-specific thread and needle are used. Direct visualization of the ligament is suggested, increasing the dissection required. **(Manning and Arnold, 2014)**

Veronikis ligature carrier

The instrument's bite mechanism permits placement of the upper and lower jaw on the anterior and inferior aspect of the coccygeus muscle-sacrospinous ligament complex under direct surgical visualization **(Veronikis and Nichols, 1997)**.

The Capio suturing device:

The Capio is a 32-cm long device, which facilitate suture placement in deep and difficult access spaces blindly as it was created to throw, catch, and retrieve suture in one time thus minimizing incision and dissection of tissues **(Leone Roberti Maggiore et al., 2013).**

The fixed blunt head has an 8-mm-wide needle capturing area at its base. Its blunt tip is 4 mm wide, and when it impresses the ligament at a recommended angle of 45°, a manually loaded needle and thread is carried forward from it by a fine sheathed, sharp, and tightly curved needle driver. The needle takes a smooth concave pathway through the ligament returning towards the surgeon where it is captured in the fenestrated base **(Manning and Arnold, 2014).**

The design of the device allows suture placement without penetration beyond the ligament. During a cadaveric study conducted by Manning and Arnold, the capio did not protrude beyond the ligament in any case **(Manning and Arnold, 2014).**

Capio device reduces the operative time, dissection into the pararectal space, in fact, wide dissection and retractors placement are not needed to visualize the ligament, because it is enough to use a blunt dissection to the pararectal space, palpating the ligament and placing the sutures **(Kapoor et al., 2017).**

The ischial spine is palpated, and the first suture is placed approximately 2 cm medial to the ischial spine. The second suture is placed at approximately 1cm medial to the initial suture. Care is taken to obtain a good grip of the ligament below the superior margin to avoid nerve entrapment. Inferior placement of sutures in the iliococcygeus muscle rather than in the sacrospinous ligament, results in vaginal shortening. palpation is used to confirm the appropriate location of each suture **(Gutman,2020)**

Delayed absorbable sutures have an advantage over permanent sutures as they can be placed through the full thickness of the vaginal epithelium and may be easier to remove in cases of nerve entrapment and severe persistent buttock pain. When choosing nonabsorbable sutures, a pulley stitch is performed by securing one end of the suture into the fibromuscular layer of the apex beneath the vaginal mucosa. **(Hamdy et al., 2019).**

Traction applied to the free end pulls the vagina to the ligament where it is fixed in place with a square knot. **(Gutman,2020).**

In the setting of Sacrospinous hysteropexy in which the uterus is preserved, two or three sutures transfix the sacrospinous ligament to the cervix at uterosacral insertion or directly to uterosacral ligaments. An apical approach is often preferred. **(Gutman,2020).**

It is advisable to perform any required procedure before tying the sacrospinous sutures including anterior colporrhaphy, enterocele repair, starting the proximal posterior colporrhaphy or cuff closure as all these procedures are more difficult to perform once the cuff sutures are transfixed to the sacrospinous ligament. The remainder of the posterior colporrhaphy and perineorrhaphy can then be completed. A rectal examination should always be performed to exclude injury following fixation and posterior colporrhaphy. **(Gutman,2020)**

Complications

Development of anterior compartment prolapse.

Development of cystocele following SSLF is a common problem with incidences ranging from 5.8 to 21.3% **(Petri and Ashok, 2011).**

Posterior deviation of the vagina leads to widening of the anterior compartment and that is exaggerated by primary damage of neuromuscular support **(Dietz et al., 2008).**

Although anatomical descent of the anterior vaginal wall appears to be common, it is asymptomatic in most patients. Symptomatic anterior vaginal wall descent requiring treatment occurs in 3–5% of patients undergoing SSLF **(Toglia and Fagan, 2008).**

Intra-operative hemorrhage

Severe intraoperative hemorrhage requiring transfusion ranges from 0.5 to 2.5% in several studies and is proportionate to the extent of dissection to visualize the ligament, thus using suture capturing devices that do not require extensive dissection helps to reduce the incidence of bleeding. **(Petri and Ashok, 2011).**

Bleeding during SSLF commonly occurs due to injury to the inferior gluteal artery, pudendal artery, the sacral venous plexus, and arterial anastomoses at the posterior side of the sacrospinous ligament. The hemorrhage can be controlled by pressure, cautery, packing, vascular clips, or angiographic arterial embolization **(Araco et al., 2008).**

Gluteal pain

Several studies reported that gluteal pain was the most common complication associated with the procedure with incidence ranges from 6.1 to 55%. the nerve supply to the coccygeus and levator ani muscles arise from the S3 to S5 roots and run on the mid-portion of superior surface of the sacrospinous ligament where the sutures are usually placed. Entrapment or injury of these nerves can result in gluteal pain, muscle spasm and pelvic floor dysfunction **(Ferrando and Walters, 2018).**

Several studies concluded that the pain is self-limiting and usually subsides within 6 weeks after surgery without intervention, The pain is usually treated by simple analgesics, opioids, physical therapy, and trigger point injection. However, if the pain is severe, persistent, and intractable with radiation down the leg or associated with muscle weakness or difficulty in walking, then reoperation and removal of sacrospinous sutures within the first 1 to 2 weeks is needed **(Unger and Walters, 2014).**

Late sutures complications

Late suture complications encompass wide range of symptoms including watery vaginal discharge, deep-seated vaginal pain, erosion of vaginal mucosa and exposure of sutures. Thea are usually associated with the use of nonabsorbable suture material sutures (Prolene, or polyester sutures). These complications were reported in 13.3% to 35% of patients particularly in postmenopausal women with evidence of vaginal atrophy. **(Hamdy et al., 2019).**

Other complications of SSLF include injury to rectum, or bladder. Although these complications are rare, the most serious is rectal injury Rectal tears should be repaired with a two-layered closure while suture injuries require intraoperative diagnosis and removal of the suture. **(Gutman, 2020) (Sori et al., 2022).**

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