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Original Article

Translevator posterior intravaginal slingplasty: anatomical landmarks and safety margins

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Abstract The posterior intravaginal sling is a new tension-free needle suspension technique. It is used for the treatment of middle compartment (vaginal vault or uterine) prolapse. The Prolene sling suspends the vagina at the upper border of level II support as described by DeLancey (Am J Obstet Gynecol 166:1717, 1992). Human cadaveric dissections were undertaken to explore the pertinent anatomy that is involved when using this blind needle technique. Pre-dissected cadaveric material was used to obtain didactic illustrations of the anatomy of the procedure. Description of the surgical technique using anatomical landmarks and relative distances of the needle to these landmarks will improve the surgeon's visual understanding of the procedure. The measurements obtained demonstrate that the needle stays at a minimal distance of 4 cm away from the major (pudendal) vessels that could potentially cause life-threatening haemorrhage.

Keywords Anatomy · Infracoccygeal sacropexy · Vaginal vault prolapse

Stefan Smajda and Piet Hinoul contributed equally to this paper

Introduction

Midurethral needle suspensions used for the treatment of urodynamic stress incontinence have raised interest in the use of meshes and other needle suspensions in the treatment of female incontinence and urogenital prolapse. The infracoccygeal sacropexy was first described by Petros in 2001 [1]. The posterior intravaginal sling (IVS Tunneller, Tyco Healthcare, Norwalk, Conn., USA) tries to offer a minimally invasive procedure such as sacrospinous ligament fixation or sacrocolpopexy for the correction of apical vaginal prolapse. Cadaveric dissections were undertaken to improve comprehension of the anatomy involved in performing a posterior IVS procedure.

Materials and methods

Dissections and surgical procedures were performed on a total of nine embalmed whole female cadavers (3% formaldehyde) at the Department of Human Anatomy of the University of Limburg, Belgium.

Initially the technique was performed on three embalmed cadavers. The IVS suspension needle that is used during a posterior IVS procedure was inserted prior to anatomical dissection for surgical landmarks. This method, however, did not achieve optimal quality illustrations of the anatomy of the procedure. Therefore, we decided to use pre-dissected specimens. The IVS suspension needle was inserted in six of these pre-dissected specimens in a similar way. No differences in the anatomy under consideration could be observed between the left and right hemipelves. The anatomical dissections were performed by anatomists on instructions of gynaecologists experienced with the posterior IVS with regard to anatomical landmarks that needed to be exposed to demonstrate the course of the IVS suspension needle. Distances between vital structures in the pelvis and the IVS suspension needle were measured and presented as averages of a total of 12 measurements.

The needle insertion technique was performed as originally described by Petros [1]:

Step 1: The dissection is initiated with a longitudinal or transverse incision at the posterior vaginal wall 1–2 cm inferior to the cervix or to the vault. On both sides of this incision a blunt pararectal dissection is performed until the pelvic side of the levator plate is reached.

Step 2: The IVS suspension needle is inserted through a small skin incision 2 cm lateral and below the external anal sphincter (left and right). The needle perforates the skin, the subcutaneous adipose tissue and enters the ischiorectal fossa.

Step 3: The shaft of the IVS suspension needle is gripped at the level of the curvature (4–5 cm from the tip) to avoid excessive forward travel. The needle is pushed forward parallel to the rectum in the direction of the ischial spine and is guided by a finger placed in the vagina.

Step 4: At the most cranial part of the ischiorectal fossa, the levator ani muscle is perforated at the level of a small depression that can be easily palpated medially to the ischial spine.

Step 5: Once the levator plate is perforated, the IVS suspension needle is directed medially to perforate the rectovaginal fascia at the level of the apex: point C represents either the most distal (i.e. most dependent) edge of the cervix or the leading edge of the vaginal cuff (hysterectomy scar) [2]. The tape is anchored to the apex of the vaginal vault, to the uterosacral ligaments or to the posterior side of the supravaginal part of the cervix. Finally, the tape is gently stretched by pulling on each perineal end, and left tension free and unfixed.

Results

The IVS suspension needle is inserted 2 cm inferolateral to the external anal sphincter (5 and 7 o’clock relative to the anus). This point of entry is situated halfway between the coccygeal bone (1) and the tuber ischiadicum (2) (10 cm). The needle perforates the skin, the subcutaneous adipose tissue and enters the ischiorectal fossa (3). The caudal border of m. gluteus maximus (4) is 1.5 cm dorsal to the point of insertion; hence, the muscle was not perforated in our cadaver specimens (Fig. 1).

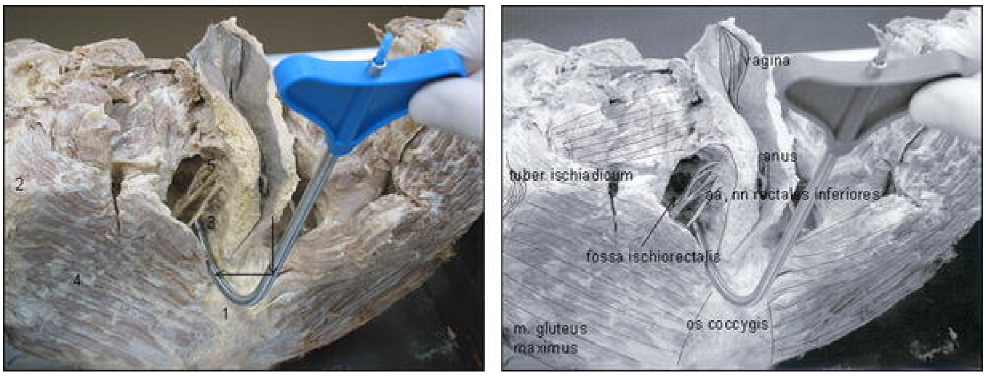

Fig. 1 Lithotomy position, caudal view: os coccygis (1), tuber ischiadicum (2), ischiorectal fossa (3), m. gluteus maximus (4), aa., vv. and nn. rectales (haemorrhoidales) inferiores (5). *Arrows* indicate the localisation of the skin incision sites.

The inferior rectal (haemorrhoidal) vessels and nerve (5) leave the main trunk of the pudendal vessels and run in the posterior part of the pudendal canal, more specifically near the ischial spine. They traverse the ischiorectal fossa in a horizontal plane (with patient in a supine position) 4 cm cranial to the external anal orifice. In the cadaveric specimens the needle passes 1.5 cm dorsal to these neurovascular branches and curves around them 1.5 cm cranially. These branches of the pudendal neurovascular bundle (6) can be injured if insertion of the needle occurs at the level of the anus or when the IVS suspension needle traverses the ischiorectal fossa less than 4 cm before curving.

The IVS suspension needle traverses the ischiorectal fossa (3) for 9 cm cranially, lateral and inferior to the cone-shaped m. levator ani (7). At the most cranial part of the ischiorectal fossa (3) the m. levator ani (7) is perforated (Fig. 2).

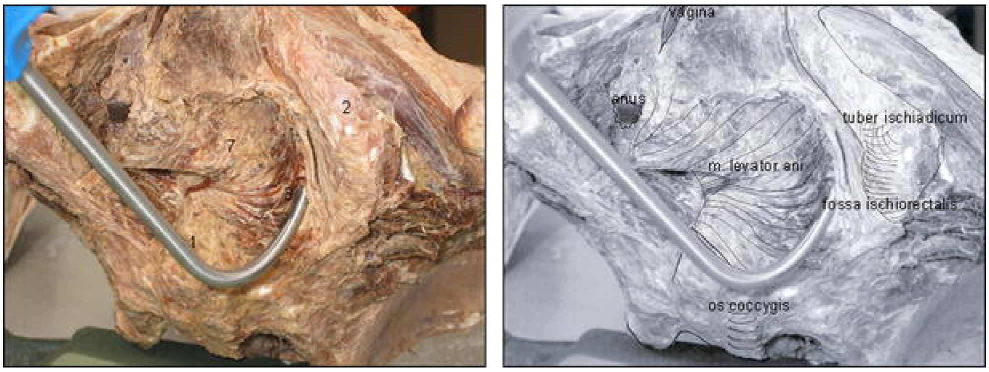

Fig. 2 Lithotomy position, lateral view of the left side: os coccygis (1), tuber ischiadicum (2), ischiorectal fossa (3), m. levator ani (7).

The iliococcygeal part of m. levator ani (8a) is perforated at the height of a small depression between the border of the pelvic aspect of the sacrospinous ligament (m. coccygeus) (9) and m. levator ani (7), situated 1.5 cm medially to the ischial spine (10) (Fig. 3).

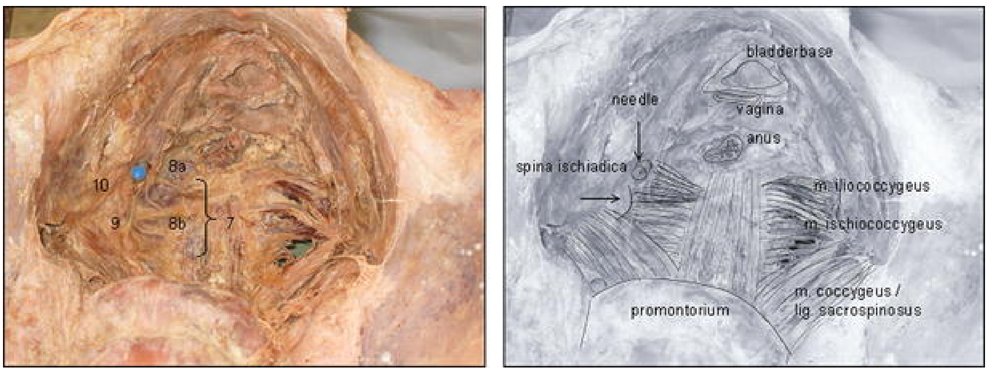

Fig. 3 Lithotomy position, superior view: m. levator ani (7), iliococcygeal part of m. levator (8a), ischiococcygeal part of m. levator (8b), sacrospinous ligament and m.coccygeus (9), ischial spine (10).

The m. levator ani is perforated 4 cm caudal to the pudendal neurovascular structures (6). In this neurovascular bundle the pudendal nerve is the most medial structure. The pudendal artery is situated lateral to the nerve. Lateral to the artery run one or two pudendal veins. The utmost lateral structure in the bundle is a small nerve branch destined for the m. obturatorius internus (Fig. 4).

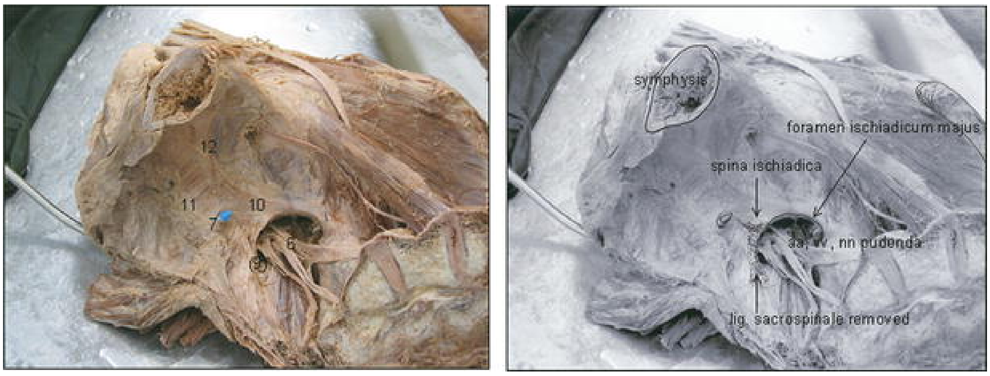

Fig. 4 Lithotomy position, lateral side wall of right side of pelvis, inside view: aa., vv. and nn. pudenda (6), m. levator ani (7), sacrospinous ligament removed (9), ischial spine (10), arcus tendineus fasciae pelvis (*white line*) (11), arcus tendineus levator ani (12).

The rectovaginal fascia (13) is perforated. The IVS suspension needle is angulated medially, remaining caudal and ventral to the pouch of Douglas. The distance to the anterior side of the rectum is 1.5 cm. Lateral to the rectum the mesh is positioned at a distance as close as 0.5 cm away from the serosa. This distance, however, underestimates the distance that the serosa is actually away during the positioning of the tunneler. Because the virtual space of the pararectal fossa is opened in a blunt fashion before positioning the tunneler, perforation of the levator plate can occur while pushing the rectum towards the contralateral side, several centimetres away from the needle's trajectory. Localisation of the outer margin of the rectum is facilitated by inserting a rectal pack (Fig. 5).

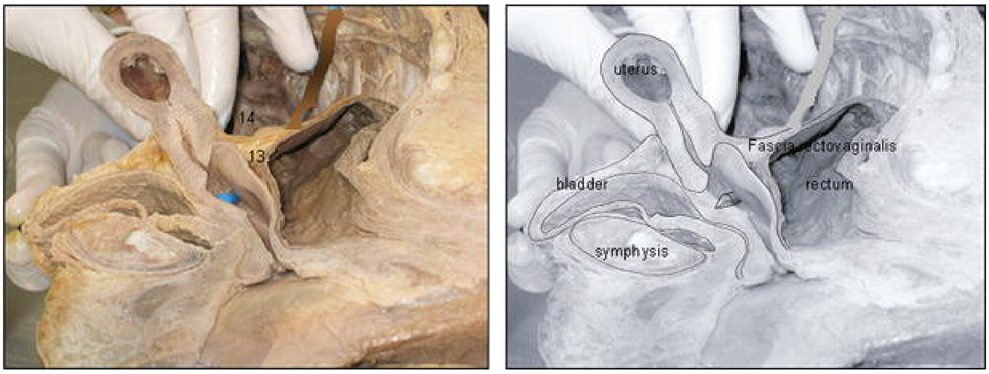

Fig. 5 Upright position, right side of pelvis, midsagittal view: rectovaginal fascia (13), pouch of Douglas (14).

The trajectory of the IVS illustrates its proximity to the rectum, the point of perforation of the m. levator ani and the axis of the vagina directed towards the third sacral vertebra (Fig. 6).

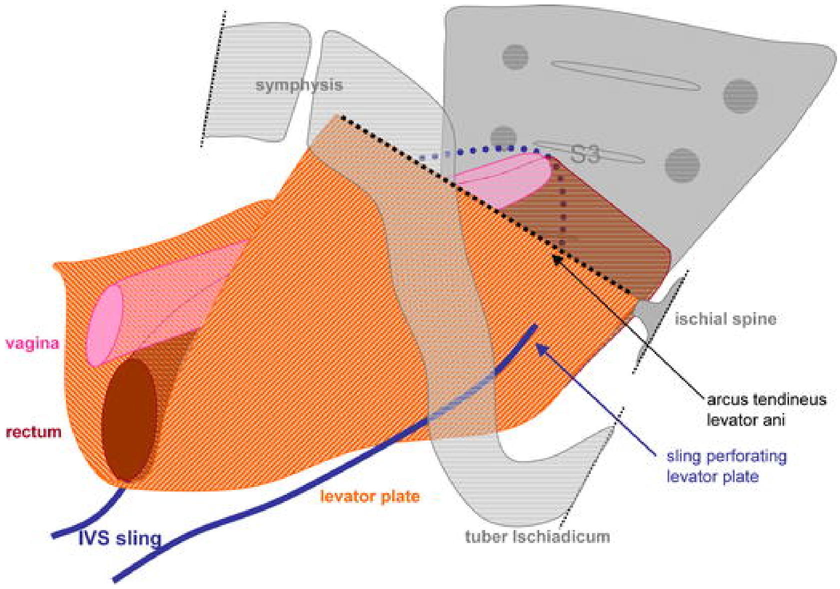

Fig. 6 Lithotomy position, lateral view of the left side of the m. levator ani, with its insertion on the pelvic side wall at the arcus tendineus levator ani.

Discussion

The dissections were undertaken to describe the trajectory of the IVS suspension needle relative to vital structures in the pelvis, in particular neurovascular structures. Visual depiction of the applied anatomy as shown in this article hopefully will result in an improved understanding of this "blind"/closed procedure. Although the real safety and efficacy of the posterior IVS procedure remains to be demonstrated in appropriately designed clinical trials, thorough knowledge of the anatomical landmarks is a basic prerequisite. As embalmed bodies were used, inferences on the safety of the technique cannot be made as we are well aware that differences exist between the anatomical specimen and the pelvis of a live patient operated on.

Petros [1] in his article describes the procedure as a "level I" reconstruction. According to our study, however, the IVS device passes 1.5 cm medial to the ischial spine through the iliococcygeus muscle. By definition, level I support is limited to the cardinal-uterosacral ligament; therefore, it seems more appropriate to state that the IVS procedure suspends the vagina at the upper border of level II, the support of the midvagina via lateral connections to the arcus tendineus fasciae pelvis [3].

From an anatomical perspective, the posterior IVS offers a more anatomical position of the vagina as it attaches the top (almost) to the level of its original position, namely the ischial spine. In comparison, the sacrospinous fixation will stretch the vagina in a more posterior and superior fashion [4]. The sacrocolpopexy does restore the normal anatomical position in the hollow of the sacrum (S3). However, surgery at this level can be complicated by the presence of presacral veins. Often the fixation of the mesh in these instances will be made at a higher level (S1-2), resulting in overcorrection with stretching of the vaginal vault. In both these procedures then the vagina is subjected to abnormal pressure predisposing the patient to develop iatrogenic prolapse of the posterior vaginal wall.

Finally, we would like to suggest "translevator intravaginal slingplasty" as an anatomically more appropriate term for the "infracoccygeal sacropexy" originally described by Petros [1].

Conclusion

Thorough knowledge of anatomy is essential for surgery. Applied anatomy is especially useful to improve the understanding of needle suspension techniques, as part of these are blind. All surgeons should be encouraged to use cadaveric studies prior to endeavouring to perform these new techniques. The cadaveric studies demonstrate that the IVS procedure is actually a suspension of the vagina at the upper border of DeLancey level II rather than a reconstruction of the level I support. The average distance between the needle used to perform the posterior IVS procedure and the pudendal neurovascular bundle is 4 cm, as measured on cadaveric specimens.

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