Transobturator tape: variation in the vascular anatomy of the obturator foramen

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Aims: *1) To describe the anatomy of the obturator canal and variations in placement of the obturator nerve, artery and vein and 2) To record the proximity of these structures to the optimal point of placement of the transobturator tape (TOT) trochar.*

Methods: *Eighteen obturator foramens were dissected in nine female cadavers. The obturator nerve, artery and vein were exposed as they entered the foramen. Orientation of the obturator nerve, artery and vein from medial to lateral were recorded. Obturator arterial and venous branches > 1 mm crossing the obturator membrane were noted. Usual placement of the TOT trochar as it passes through the obturator membrane to the obturator canal was determined and the distance from the trochar to each of the structures was recorded.*

Results: *The medial to lateral orientations of the obturator nerve, artery and vein are variable where these structures enter the obturator canal. The vein appeared most medially in 78% of cadavers and the artery in 22%. The nerve was located most lateral in all cases. Venous (22%) and arterial (17%) branches of the obturator vessels traversed medially across the obturator membrane towards the side of trochar placement.*

The mean distance from optimal trochar placement to the obturator canal was 30 mm.

Conclusions: *The anatomy of the obturator foramen is not consistent. The proximity of the obturator canal to the TOT trochar, the medially crossing obturator nerve, artery and vein and their branches, as well as their variable orientation in the canal should be considered when performing the transobturator tape procedure.*

Key Words: obturator canal, cadaver, stress urinary incontinence, trans vaginal tape

Introduction

In 2001, Delorme and colleagues introduced the transobturator tape or sling technique in humans[1] as an alternative to the abdominal Burch colposuspension. The Burch procedure has long been considered the gold standard for surgical treatment of stress urinary incontinence (SUI),[2] and is still widely used[3] despite the invasiveness of the procedure. More recently, the trans vaginal tape (TVT) procedure has been adopted by many practitioners,[3] although there is insufficient information in the literature to demonstrate how well TVT compares with the Burch procedure or conservative treatment in terms of outcome.[4] Perioperative complications have been reported to be as high as 27%.[5]

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The transobturator technique is considered as quick and at least as effective as TVT.[6] Early reports indicate that it has a lower incidence of complications.[1,5,7,8] Only one study reported a perioperative complication rate as high as 14%, including bladder and urethral perforations and vaginal injuries, all of which occurred during the learning phase,[9] while a second reported a postoperative erosion rate as high as 15%.[10]

The procedure is performed blindly, and our knowledge base concerning the normal obturator and its variants is limited. As remarked in the editorial comment on Whiteside and Walters' study of the anatomy, "this has implications for the safe performance of this procedure".[11]

This study was undertaken to increase the knowledge base of the anatomy of the obturator canal, describe the variations in the arterial and venous anatomy of the obturator vessels, and record the proximity of the vascular structures to the optimal point of placement of the TOT trochar.

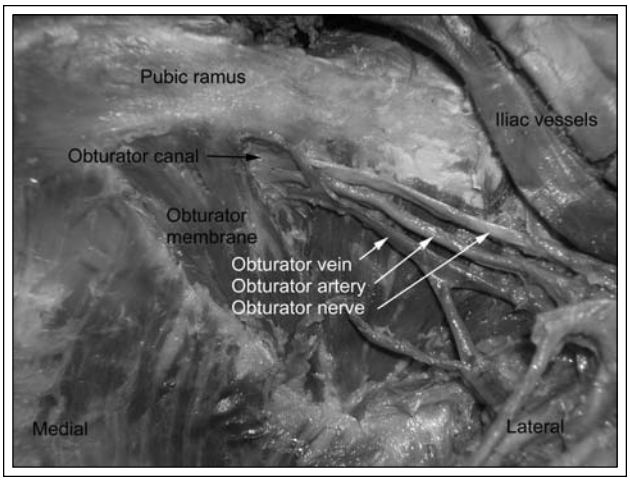

Figure 1. Common location of anatomical structures of the right obturator foramen.

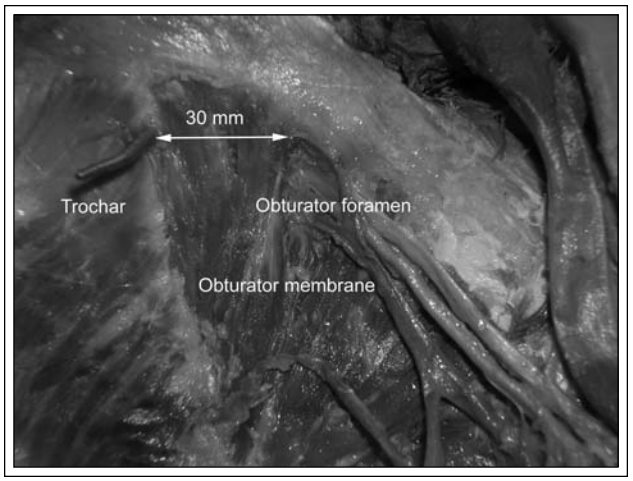

Figure 2. Placement of the trochar relative to anatomical structures of the obturator foramens.

Materials and methods

Nine adult female cadavers were dissected in the lithotomy position. Eighteen obturator foramens were carefully dissected from these cadavers to provide both abdominal and perineal exposure. The obturator nerve, artery and vein were exposed as they entered the foramen. Orientation of the obturator canal contents and the order of the obturator nerve, artery and vein were recorded. Arterial and venous branches > 1 mm crossing the obturator membrane were noted.

The usual placement of the TOT trochar as it passes through the obturator membrane to the obturator canal was determined and the distance from the trochar to each obturator nerve, artery and vein was measured and recorded for analysis, Figures 1 and 2.

Results

The medial to lateral arrangement of the nerve, artery, and vein crossing the obturator membrane was variable. In all cadavers studied, the nerve was most lateral. In 14 of 18, the vein was most medial, while the artery was most medial in the other four, Table 1.

The distance from each of the canals to the position of the trochar as well as to the pubic symphysis was recorded in each of the dissections, Table 2. The mean distance from optimal trochar placement to the obturator canal was 30 mm.

Our dissections revealed a significant number of venous (22%, 4 of 18) and arterial (17%, 3 of 18) branches which crossed the obturator membrane medially towards the site of trochar placement. The

TABLE 1. **Arrangement of the obturator nerve, artery and vein**

Cadaver	Order of right nerve, artery, vein Anteromedial to posterolateral	Order of left nerve, artery, vein Anteromedial to posterolateral
4	VAN	VAN
18	VAN	AVN
6	VAN	VAN
20	VAN	VAN
7	AVN	AVN
25	AVN	VAN
8	VAN	VAN
10	VAN	VAN
13	VAN	VAN

TABLE 2. **Obturator canal distances in cadavers**

Cadaver #	Right obturator canal to trochar direct (mm)	Left obturator canal to tochar direct (mm)	Right obturator canal to pubic symphysis (mm)	Left obturator canal to pubic symphysis (mm)
4	30	27	56	55
18	31	39	56	57
6	27	22	42	52
20	27	31	54	55
7	23	28		
25	33	26	52	49
8	31	27	50	50
10	21	24	51	55
13	50	43	57	56

TABLE 3. **Obturator foramen arterial and venous anomalies**

Cadaver #	Right venous anomalies	Left venous anomalies	Right arterial anomalies	Left arterial anomalies
4	Nil	Branch to external iliac vein	Nil	Nil
6	Nil	Branch to external iliac vein	Artery off external iliac only; no branch off internal iliac artery	Nil
7	Nil	Nil	Artery off posterior branch of internal iliac (terminal)	Branch of artery prior to piercing membrane extends directly medial across membrane (1 mm)
8	Branch to external iliac vein, 1, 1.5 and 2 mm	Branch to external iliac vein	Nil	Nil
13	Branch to external iliac vein	Nil	Nil	Nil
18	Vein off external iliac vein only; 1 mm branch across obturator membrane	Branch to external iliac vein	Nil	Nil
20	Branch to inferior epigastric vein	Branch to external iliac vein	2 medial branches across membrane (1+1 mm)	Nil
25	Branch to external iliac vein	Nil	Artery only off external iliac artery	

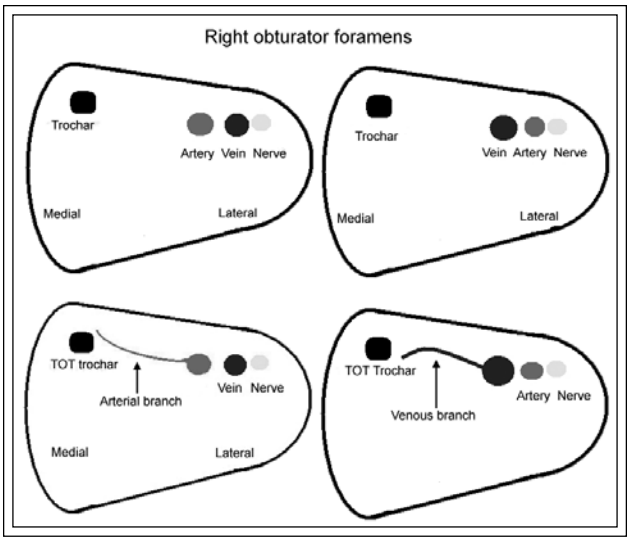

Figure 3. Illustrations showing the various orientations of the obturator nerve and blood vessels in the right obturator foramen revealed during cadaver dissection.

size and positions of these structures is reported in Table 3. Anomalies were found in 15 of 54 (28%) positions of the obturator artery, vein and nerve, see Table 3 and Figure 3.

Discussion

The transobturator tape or sling was designed to replicate the natural support provided by the urethral fascia.[12] The transobturator tape technique involves placing polypropylene tape using a trochar into one obturator foramen, via the vaginal wall, and out the other obturator foramen. Small incisions are made in both groins and another in the vagina under the urethra. The trochar used to place the tape is passed through one of the groin incisions and the obturator membrane, around the descending ischiopubic ramus, through the opposite obturator membrane and out the opposite groin incision. The surgeon places a finger in the vaginal incision to guide the trochar through its course and to ensure correct placement of the tape. The area through which the trochar and tape pass is considered to be "low risk" because it does not house any major arteries, veins or nerves.[1,13,14]

There are risks involved with any surgical procedure. The Burch colposuspension procedure requires a general or spinal anesthetic and opening of the abdomen, although it can also be performed laparoscopically.[15] Less invasive and faster techniques are associated with reduced risk of complications. Passage through the retropubic space with the TVT approach has been associated with an incidence of complication of between 2.3% and 27%.[5] Because the transobturator tape technique does not involve passage through the retropubic space and does not involve abdominal incisions or a general anesthetic, it is considered both less invasive and faster.[1,6,12,14]

Although initial reports in both clinical and cadaveric studies suggest that complications can be reduced using the transobturator approach,[16] there are numerous citations of perioperative and postoperative complications, some of which might be avoided with greater awareness of the varying anatomy of the obturator foramen. In particular, there are reports of perioperative hemorrhage[5,17-20] and postoperative hematoma,[5,18,21] transient or persistent pain,[5,19] urinary retention or dysuria,[1,5,7,9,18,19,22] neurologic deficits[18,19] and erosions often accompanied by infection and/or abscess.[7,10,18,19,22-24]

Thorough knowledge of the anatomy of the area involved is critical to the safe performance of the surgical procedures. The available descriptions of the location and variability of the nerves and blood vessels of the obturator foramens are limited.[11,13,25-27]

Delmas et al provide an excellent summary of the standard anatomy of the obturator foramen. Although they performed dissections on 10 cadavers, including vascular variants of the obturator artery, no measurements were provided. They report a distance of 2 cm between the terminal branches of the obturator nerve and the path of the trochar.[25]

In Bonnet et al's study of the transobturator tape "inside out" procedure in five cadavers, the distance from the tape (which corresponds to the trochar location in our study) to the obturator nerve was 22 mm-30 mm (mean $\pm$ SD 26.2, median 25.5). The shortest distance was measured at the level of the obturator membrane, and beyond the obturator membrane, the location of the trochar and the nerve diverged. The authors reported that the anterior branch of the obturator artery followed the external rim of the inferior pubic ramus, with no variability reported.[13]

As part of Ersoy et al's study of the pelvic fascia in five cadavers (pelvic halves), they reported that the location of the obturator nerve was invariable, but there was variation in both the obturator vein and artery. In one cadaver, the obturator vein extended from the ischial spine to the obturator canal bilaterally. In four cadavers, branches of the obturator vein were located vertically on the obturator internus under the obturator membrane, but the branches were considered too small to be of clinical concern (i.e., hemorrhage).[25]

Whiteside and Walters[11] studied five cadavers and found that "a trans-obturator device would pass on average 1.1 cm (SD +/- 0.4, range 0.5-1.4 cm) from the most medial branch of the medial division of the obturator vessels." The authors concluded that proximity of the blood vessels and nerves to the trochar placement warrants further anatomical study.

The orientation of structures in the obturator foramen is frequently different than classically described in anatomy texts, which report their orientation with limited discussion of their variability. Gray's Anatomy reports that the obturator artery sometimes arises from the main stem or posterior trunk of the hypogastric, from the superior gluteal artery, and occasionally from the external iliac. In about two out of every seven cases it arises from the inferior epigastric, descending almost vertically to the upper part of the obturator foramen, where it usually lies in contact with the external iliac vein on the lateral side of the femoral ring, or occasionally curving along the free margin of the lacunar ligament.[27] Our study shows that, in approximately 20% of obturator foramina, arterial or venous branches > 1 mm cross medially towards the site of optimal TOT trochar placement. Thus the obturator foramen contains arteries, veins and nerves that may be at risk during a transobturator tape procedure in some patients. To date, reports of hemorrhage or nerve injury have been rare.[5,28] However, since the transobturator tape procedure is a recent introduction to the surgical options for SUI, knowledge of possible complications is incomplete. The risk of nerve damage or a significant bleed are probably minor but should be considered in performing the procedure.

Conclusions

The anatomy of the structures of the obturator foramen varies from individual to individual and even from left to right. As a result, insertion of the transobturator tape has the potential to injure the nerve, artery or vein of the obturator foramen. □

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