INTRODUCTION

Urinary incontinence (UI) is the involuntary leaking of urine and is a common symptom affecting women of all ages. It can have a significant impact on the physical, psychological and social wellbeing and quality of life (QoL) of affected women ***(Abrams et al., 2003).***

The prevalence of UI is difficult to estimate as it is usually under-reported. UI has often been considered as a natural consequence of the aging process; other women consider it an embarrassing issue, which is unacceptable to discuss with others. Some women are not aware of the available management options or have a fear of the surgical treatment ***(Hunskaar et al., 2004).***

Stress urinary incontinence (SUI) is estimated to affect up to 35% of adult women worldwide, leading to deterioration in Quality of life (QoL) ***(Luber, 2004).***

Retropubic and transobturator tension-free midurethral slings (standard midurethral slings (SMUS) represent the most effective and popular procedures for the surgical treatment of SUI and are currently considered the gold standard ***(Novara et al., 2010).***

Traditional surgical therapies including retropubic colposuspension and autologous sling procedures have proven successful in treating SUI. However, these methods are invasive and often require general or regional anesthesia ***(Nilsson et al., 2008).***

However, retropubic tension-free tape procedures have been associated with a number of attendant morbidities including bladder perforation, pain, voiding dysfunction, de novo urge incontinence, as well as more serious complications such as major vessel and nerve injury, and even death ***(Moore et al., 2009).***

The transobturator approach to the tension-free tape sling was developed to help minimize the morbidity associated with blind retropubic needle placement by passing through the groin and obturator space away from the viscera and neurovasculature ***(Delorme et al., 2001).***

The transobturator approach appears to have efficacy comparable to that of the retropubic approach as demonstrated in various randomized and non-randomized trials. This approach is also thought to place the sling in a more natural position that mimics the pubourethral ligament, and its attachment to the levators and pelvic sidewall muscles ***(Ross et al., 2009).***

Recently single incision mini-slings have been developed to limit the number of incisions and reduce the risks of blind needle passes through the groin or abdomen, yet mimic the position and results of the Trans-obturator tape (TOT). The single incision sling system provides such a minimally invasive approach for the treatment of female stress urinary incontinence. It uses self-fixating tips that provide immediate fixation into the obturator muscles, thereby eliminating the need for a full-length trans-obturator mesh ***(Kennelly et al., 2010).***

Single incision mini slings (SIMS) requiring very limited intracorporeal dissection have been recently introduced proposing to further increase safety of sub-urethral slings, without jeopardizing the success rates reported by conventional retropubic and transobturator access ***(Oliveira et al., 2011).***

Several advantages of the SIMS over the standard mid-urethral sling (SMUS) procedures, i.e., the retropubic Trans-vaginal tape (RP-TVT) and (TOT), including that, SIMS is associated with a shorter operative time, the procedure can be performed under local anesthesia, there is less post-operative pain, and reduced morbidity. All these features would support the use of SIMS as an office procedure ***(Hinoul et al., 2007).***

The single incision mini sling procedure is considered by many although not by all, as effective as the SMUS procedures with little postoperative pain ***(Meschia et al., 2009).***

Aim of the Work

The aim of this work is to evaluate single-incision suburethral mini-sling SIMS and to compare its results with these of trans-obturator tapes TOT as an anti- incontinence operation. As regards safety, operative time, hospital stay, post-operative pain and effectiveness of both approaches.

ANATOMY OF FEMALE LOWER URINARY TRACT (LUT)

The following sections present the anatomy and relevant structures of the female LUT, which is involved with the control of continence

A. The bladder

The bladder is a muscular organ composed of a complex network of smooth muscle fibers and elastic connective tissue, it is known as the detrusor muscle ***(Gerard et al., 2005).***

a) The trigone is a small muscular triangular area at the posterior wall of the bladder. It consists of two layers; the deep trigone muscle which is similar to the detrusor; and the superficial thin smooth muscle bundle.

b) The bladder neck is funnel-like to facilitate urine flow into the proximal part of the urethra at the start of micturition.

c) The urethra is a hollow fibro-muscular tubular structure between 3 and 5 cm in length. The wall of the urethra consists of two layers. The inner thin layer consists of longitudinal bundles of smooth muscle fibers, and the external outer layer consists of circular striated muscle fibers ***(Flynn et al., 1980).***

d) Urethral sphincters consist of:

(1) The internal urethral sphincter (IUS), which is composed of smooth muscles (bladder neck and urethra) and is under involuntary control, it receives innervation from the perineal branch of the pudendal nerve, which is responsible for keeping the bladder and upper urethra closed during the storage phase ***(Gerard et al., 2005).***

(2) The external urethral sphincter (EUS), called striated muscle sphincter or rhabdosphincter, is also referred to as the intrinsic or intramural striated sphincter. It is located at the distal end of the urethra and consists of small slow twitch fibers, which are capable of sustained contraction for long periods without fatigue; therefore, it is responsible for urethral closure at rest **(Fig. 1)** ***(Hudson et al., 2002).***

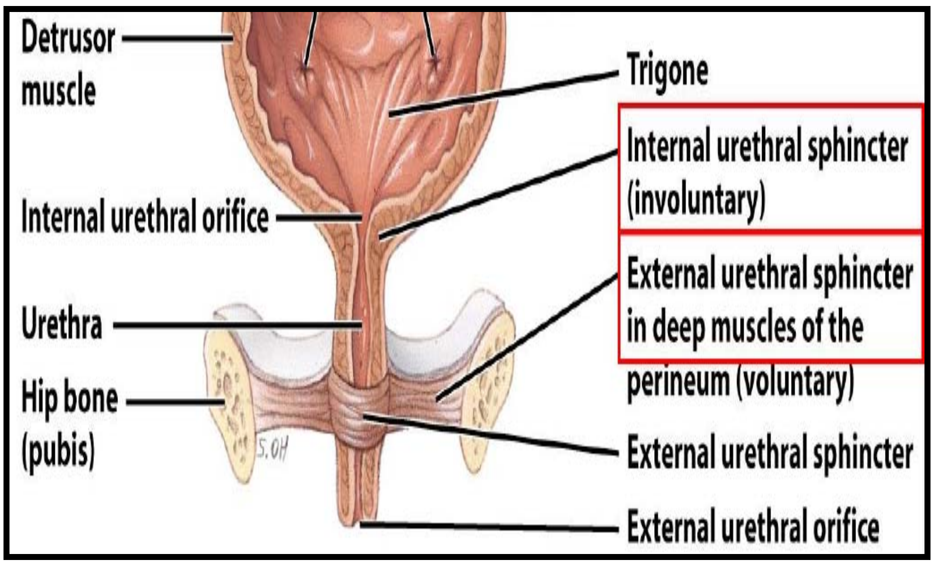


Figure (1): Urethral sphincters including the IUS and EUS ***(Gerard et al., 2005).***

B. Pelvic floor anatomy

The pelvic floor consists of layers including:

a) The endopelvic fascia:

This is the first layer of the pelvic floor configuration (Uterosacaral ligaments/ Pubocervical fascia/ Rectovaginal fascia). It is formed by a fibro-muscular connective tissue network that is "hammock-like" which attaches the cervix and vagina to the pelvic sidewall ***(Herschorn, 2004).***

b) Pelvic diaphragm:

This is the second layer of the pelvic floor (Levator ani & coccygeus); it is a layer of striated muscle with its fascial covering. It acts as a horizontal shelf to support the pelvic organs.

The levator ani is a thin, broad muscle and characterized by fast twitch muscle fibers. It attaches to the inner surface of the side of the lesser pelvis (true pelvis) and unites with the other side to form the largest part of the pelvic floor. It is critically important to pelvic organ support. The levator ani is divided into three parts: Pubococcygeus, Iliococcygeus and Puborectalis ***(Loubeyre et al., 2012)*** **(Fig. 2).**

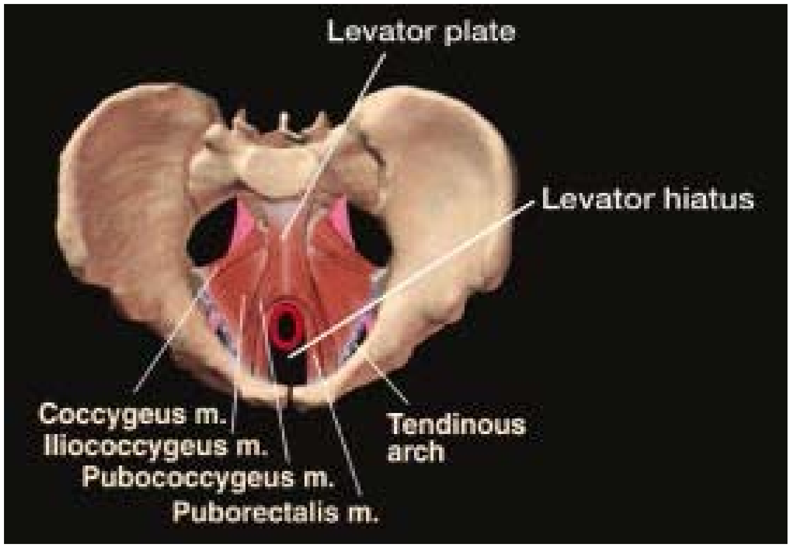


Figure (2): The female pelvic floor muscles including coccygeus muscle and parts of the levator ani muscle ***(Herschorn, 2004).***

c) The urogenital diaphragm:

It is the third layer of the pelvic floor (perineal membrane and body); it consists of the superficial & deep transverse perineal muscles with their fascial covering. The perineal membrane is a sheet of dense fibro-muscular tissue ***(Brandon et al., 2009).***

It creates a boundary between the superficial and deep perineal spaces ***(Mirilas et al., 2004)***.

It provides support to the lower vagina and urethra by attaching these structures to the bony pelvis. The perineal body is a pyramid of connective tissue mass at the junction between the posterior vaginal wall and the anus, in the midline of the perineum ***(Yavagal et al., 2011).***

Arcus Tendineus Fascia Pelvis (ATFP) is a thickened whitish band in the upper layer of the diaphragmatic part of the pelvic fascia. It joins the fascia of the pubocervical fascia that covers the anterior wall of the vagina ***(Abrams et al., 2005)*** **(Fig. 3).**

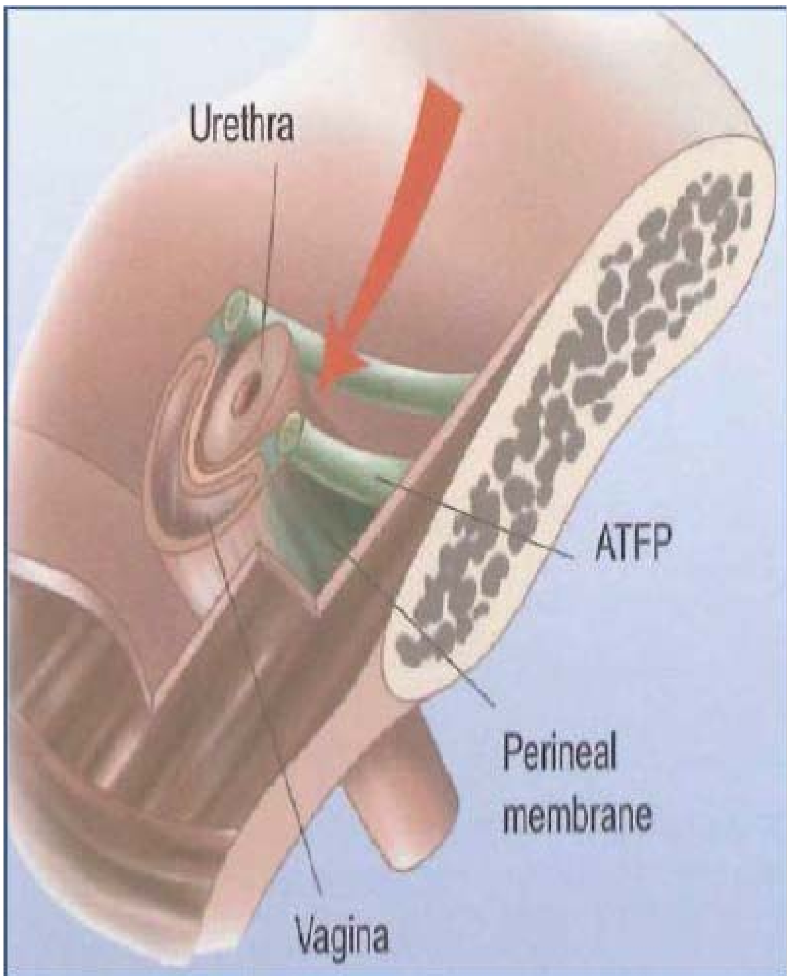


Figure (3): The urogenital triangle, the red arrow shows the direction of compression of the urethra during increased intra abdominal pressure, ATFP: Arcus Tendineus Fascia Pelvis ***(Abrams et al., 2005).***

C. The Pubo-Urethral Ligaments

The pubo-urethral ligaments in females are often considered to form the main suspensor mechanism of the urethra ***(Stanton et al., 1977)***. It is divided into anterior, posterior and intermediate pubo-urethral ligaments. Weakness of the pubo-urethral ligaments leads to urethral incompetence and SUI. The design of tension free vaginal sling is to replace the action and position of the pubo-urethral ligament to support the urethra ***(Cruikshank et al., 1997)*** **(Fig. 4).**

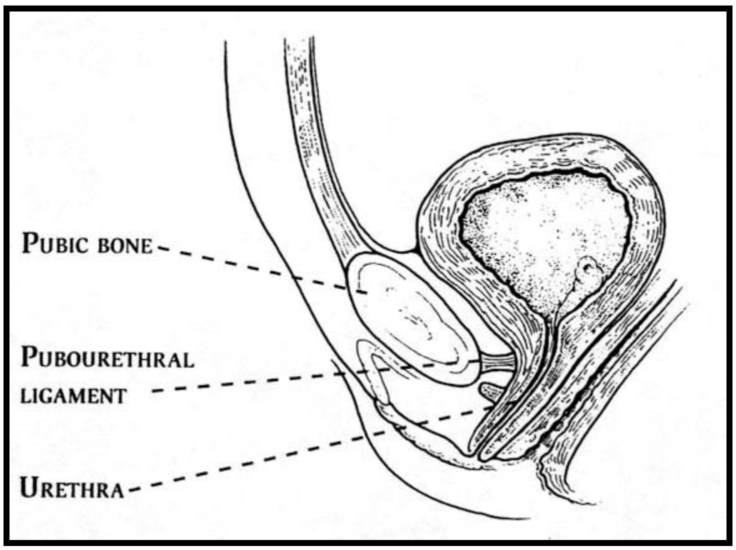
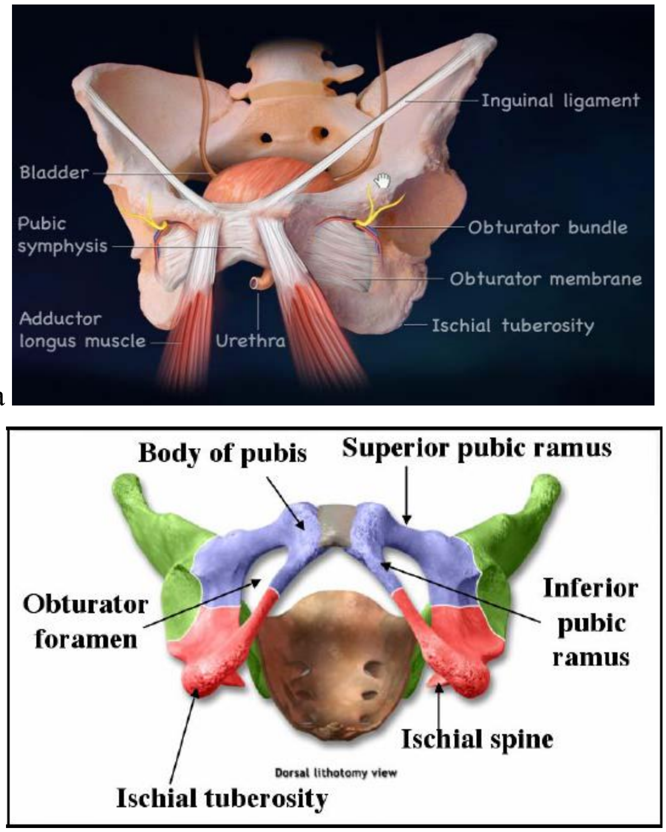


Figure (4): Pubo-urethral ligaments suspend the female urethra under the pubic arch ***(Rackley et al., 2001).***

D. Anatomy of obturator canal *(Morrison et al., 2002).*

The obturator foramen is a large aperture, situated between the ischium and pubis. In the male it is large and of an oval form, its longest diameter slanting obliquely from before backward; in the female it is smaller, and more triangular. It is bounded by a thin, uneven margin, to which a strong membrane is attached, and presents, superiorly, a deep groove (the obturator groove) which runs from the pelvis obliquely medial and downward. This groove is converted into a canal by a ligamentous band, a specialized part of the obturator membrane, attached to two tubercles: one, the posterior obturator tubercle, on the medial border of the ischium, just in front of the acetabular notch; the other, the anterior obturator tubercle, on the obturator crest of the superior ramus of the pubis. Through the canal the obturator vessels and nerve pass out of the pelvis. The bony boundaries of the obturator foramen include the superior pubic ramus, body of the pubis, inferior pubic ramus, and the ischium, where they fuse together with the inferior part of the ileum. The obturator foramen is densely filled by a tough, fibrous sheath, (the obturator membrane) **(Fig. 5)**.

The obturator membrane is a thin fibrous sheet, which almost completely closes the obturator foramen. Its fibers are arranged in interlacing bundles mainly transverse in direction; the uppermost bundle is attached to the obturator tubercles and completes the obturator canal for the passage of the obturator vessels and nerve. The membrane is attached to the sharp margin of the obturator foramen except at its lower lateral angle, where it is fixed to the pelvic surface of the inferior ramus of the ischium. Both obturator muscles are connected with this membrane.



a

b

Figure (5): Obturator canal Anatomy: **(a)** Boundaries of obturator foramen, **(b)** Obturator membrane and neurovascular bundle

The obturator nerve, artery and vein

The obturator membrane has a small opening in the superior, lateral corner, which allows for passage of the obturator artery, vein and nerve. Upon exiting the obturator canal, the obturator artery, vein and nerve, are 2.5 to 3 cm lateral from the outer edge of the inferior pubic ramus. The anterior and posterior branches of the obturator nerve course laterally and away from the inferior pubic ramus when the patient is placed in the dorsal lithotomy position. Each of the vessels bifurcate into anterior and posterior branches after exiting the obturator canal. The anterior branch of the obturator artery courses medially within tendinous tissue along the exterior edge of the obturator foramen. The posterior branch of the obturator artery courses laterally and posteriorly along the edge of the obturator foramen away from the inferior pubic ramus.

Muscles related to the obturator foramen

The muscles related to the obturator foramen include: the adductor brevis, adductor longus, adductor magnus and gracilis muscles. The adductor brevis and gracilis as well as the upper portion of the adductor magnus muscle originate from the upper area of the inferior pubic ramus. The adductor longus muscle originates from the medial aspect of the body of the pubic bone. Additional muscles include the obturator externus and internus muscles which originate from the outer and inner surfaces of the obturator membrane, respectively, and the surrounding bony edge of the obturator foramen.

The Obturator internus is situated partly within the lesser pelvis, and partly at the back of the hip-joint. It arises from the inner surface of the antero-lateral wall of the pelvis, where it surrounds the greater part of the obturator foramen, being attached to the inferior rami of the pubis and ischium, and at the side to the inner surface of the hip bone below and behind the pelvic brim, reaching from the upper part of the greater sciatic foramen above and behind to the obturator foramen below and in front. It also arises from the pelvic surface of the obturator membrane except in the posterior part, from the tendinous arch which completes the canal for the passage of the obturator vessels and nerve, and to a slight extent from the obturator fascia, which covers the muscle. The fibers converge rapidly toward the lesser sciatic foramen, and end in four or five tendinous bands, which are found on the deep surface of the muscle; these bands are reflected at a right angle over the grooved surface of the ischium between its spine and tuberosity. This bony surface is covered by smooth cartilage, which is separated from the tendon by a bursa, and presents one or more ridges corresponding with the furrows between the tendinous bands. These bands leave the pelvis through the lesser sciatic foramen and unite into a single flattened tendon, which passes horizontally across the capsule of the hip-joint, and, after receiving the attachments of the Gemelli, is inserted into the forepart of the medial surface of the greater trochanter above the trochanteric fossa. A bursa, narrow and elongated in form, is usually found between the tendon and the capsule of the hip-joint; it occasionally communicates with the bursa between the tendon and the ischium.

The Obturator externus is a flat, triangular muscle, which covers the outer surface of the anterior wall of the pelvis. It arises from the margin of bone immediately around the medial side of the obturator foramen, from the rami of the pubis, and the inferior ramus of the ischium; it also arises from the medial two-thirds of the outer surface of the obturator membrane, and from the tendinous arch which completes the canal for the passage of the obturator vessels and nerves. The fibers springing from the pubic arch extend on to the inner surface of the bone, where they obtain a narrow origin between the margin of the foramen and the attachment of the obturator membrane. The fibers converge and pass backward, lateral, and upward, and end in a tendon which runs across the back of the neck of the femur and lower part of the capsule of the hip joint and is inserted into the trochanteric fossa of the femur. The obturator vessels lie between the muscle and the obturator membrane; the anterior branch of the obturator nerve reaches the thigh by passing in front of the muscle, and the posterior branch by piercing it **(Fig. 5)**.