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PHYT 875 – Final Paper

Female Stress Urinary Incontinence

Introduction

Urinary incontinence is any condition that results in involuntary urine leakage. Stress urinary incontinence (SUI) is the leakage of urine that occurs with increased intra-abdominal pressure. Typically, an increase in intra-abdominal pressure causes a downward force and pressure on the bladder that is counteracted by urethral closing pressure (which is a component of surrounding ligament, fascia, vascular and muscular tissue). However, when there is a weakness in the surrounding tissue, the bladder pressure becomes greater than the urethral closure pressure and urine leakage occurs (see Figure 1 in Appendix). Unexpected leakage can occur during common activities, such as running, jumping, coughing, sneezing, laughing or lifting heavy objects. Both men and women are affected by urinary incontinence, but women have higher rates of stress incontinence (23.1%) compared to men (0.8%).[1] Stress incontinence is not only a physical diagnosis, but also has psychological effects as well. Many women have increased anxiety about their condition and may avoid social events and performing physical activity in fear of having an embarrassing leak; this avoidance and isolation may account for poor quality of life outcomes found in this population.[1] Despite the high prevalence of SUI, less than 38% of women actually request help for the condition.[2] This reluctance may be due to embarrassment or a lack of understanding that there is an actual solution for this problem.[1] However, strengthening exercises have been found to be extremely successfully for managing and curing this condition.[3] Conservative management can be performed by a specialized pelvic floor therapist and can include the

use biofeedback, electrical stimulation, and pelvic floor exercises to strengthen and coordinate urethral support mechanisms.[4] When conservative methods are unsuccessful, a urologist or gynecologist can prescribe medications, provide an individually fit pessary ring, implement minimally invasive injection therapy or perform surgery (i.e. urethral sling surgery) to manage the condition.[5] It is imperative that clinicians understand and are able to discuss SUI with their patients and provide referrals/treatment when necessary.

Pelvic Floor Anatomy

In order to properly understand stress incontinence, an understanding of the female pelvic floor, bladder and urethral anatomy is essential. The pelvic floor is continuous with the abdominal cavity; the levator ani and coccygeus muscles create a muscular sling between the pelvic bones and are known as the pelvic diaphgram (see Figure 2). The levator ani connects from the pubic bone to the coccyx and is composed of three separate muscles named by location: the pubococcygeus, iliococcygeus, ischiococcygeus (see Figure 3). The urethra, cervix and rectum are the 3 openings that pass through this muscle from anterior to posterior (see Figure 4). The bladder, which stores urine from the kidneys is directly proximal to the urethra, and is controlled by the detrusor muscle (see Figure 5). The urethra is connected to the bladder and its primary purpose is to maintain a closure pressure to counteract bladder pressure until the voluntary decision to void has been made, in which it will open to void urine. The urethra is surrounded by a vascular submucosa layer that indirectly allows for increased closure pressure (see Figure 6).[6] There are also internal and external mechanisms to allow for urethral closure pressure (see Figure 7). Proximal to the bladder, the internal urethral sphincter mechanism is

composed of collagen, elastin and smooth muscle. The smooth muscle of the intrinsic urethral sphincter (IUS) maintains constant tone by signaling of the sympathetic nervous system, and relaxation of the IUS occurs via the parasympathetic pathway. Distally, the extrinsic sphincter mechanism (EUS) is made up striated muscle fibers and is voluntarily controlled by the pudendal nerve.[7] The extrinsic sphincter muscles, in conjunction with the fast twitch fibers of the levator ani and other pelvic floor muscles, voluntarily contract to allow for urethral closure in response to increased bladder pressure. Relaxation of these muscles (by the parasympathetic system and voluntarily by the somatic pudendal nerve), along with the contraction of the bladder detrusor muscle, allows for the passage of urine.[7] Posteriorly, the urethra is supported by the endopelvic fascia connective tissue and anterior vaginal wall, which surrounds the urethra like a hammock.[8] With increased abdominal pressure, the urethra is pushed downward and is compressed posteriorly into this fascia, and this compressive force contributes to closing of the urethra during unexpected increases in abdominal pressure (see Figure 8).[8] Weakness of the muscular support system and/or laxity of the surrounding connective tissue and fascia decreases overall urethral closure pressure and causes urine leakage in response to increased intra-abdominal and bladder pressure.

Common Populations Affected by SUI

Pregnancy is one of the primary causes of stress incontinence. Increased uterine volume, hormonal changes and/or vaginal delivery can cause increased stretch and resultant weakness in pelvic floor muscles, preventing these muscles from providing urethral closure.[9] Pregnant women who have previously had SUI, have had multiple

births, have a high BMI or are of an older age (> 30 years) have a greater risk of developing SUI during pregnancy.[9] Moreover, women are more likely to experience SUI during the third trimester compared to the first trimester.[10] However, pelvic floor exercises during the antenatal period has been found to significantly decrease rates of SUI in patients both during pregnancy and up to 12 weeks postpartum.[11,12] Therefore, it is imperative that gynecologists and other healthcare providers recommend these exercises to their pregnant patients in order to prevent and reduce the risk for SUI.

Another population that is commonly affected by SUI is female athletes, especially those who participate in high impact activities such as running and jumping.[13] However, the exact reason why SUI occurs is unknown. One hypothesis is that due to repetitive high impact activity, female athletes overload and stretch out the pelvic floor muscles.[13] However, MRI studies have found that high level athletes had larger and stronger levator ani muscles compared to control non-athletes and that continent and incontinent high level athletes do not have significantly different strength of pelvic floor musculature.[14,15] Another small RCT suggests that increased vigorous activity results in fatiguing of pelvic floor musculature which may lead to stress incontinence.[16] The current understanding is that these female athletes may have already had weakness in their urethral support structures but only demonstrate symptoms due to the increased activity and loading demands of their sport.[13] Nonetheless, pelvic floor exercise may assist an athlete with coordination of pelvic floor activity and has been found to be successful in this population.[17]

There are other conditions and risk factors that can contribute to pelvic floor weakness and lead to SUI. For example, obesity and increased abdominal weight results

in constant increased intra-abdominal pressure that continuously strains the muscles and nerves of the pelvic floor. However, this is a modifiable risk factor for SUI, as surgical weight loss has been found to significantly reduce incontinence episodes as well as result in decreased bladder pressure in this population.[18] Even having a 5% weight loss has been found to significantly improve stress incontinence episodes in women who are overweight.[18] Women with diabetes who have poor glycemic control have a 34% risk of having stress incontinence as well, which may be secondary to continued vascular injury that can progressively affect pelvic muscle activity and the urethral submucosa layer.[19] Increased age, which results in a decrease in the number of striated muscle fibers and cross sectional area of these muscles may also result in stress incontinence, but there are typically higher rates of urge incontinence or mixed incontinence diagnoses in this population.[20] These populations, along with female athletes and pregnant women are commonly seen in an outpatient physical therapy setting and therefore the therapist should ask about stress incontinence symptoms during history intake and provide the appropriate referral if warranted.

Evaluation and Diagnosis

A gynecologist, urologist, family physician or a pelvic floor physical therapist can examine and evaluate a patient for SUI.[21] Examination begins with a thorough subjective history. Specifically for SUI, the patient will report increased urine leakage with certain activities, such as coughing, sneezing or lifting heavy objects. The patient will also be asked to provide a history about previous pregnancies, pelvic floor/abdominal surgeries and current conditions (such as diabetes mellitus) to determine if there are significant risk

factors for SUI. Furthermore, the patient should provide a medication list in order to determine if medication side effects could potentially be causing incontinence. The Urogenital Distress Inventory and the Incontinence Impact Questionnaire are two self-report outcome measures that can be used to assess the severity of the condition and assess its impact on quality of life. Both measures have been found to valid and reliable measures for use in this population.[22,23] Patients may also be asked to keep a "bladder diary", where they keep track of what/how much they are drinking, how much urine they are expelling and how many leaks they had during the day (as well as what activity they were performing when the leakage occurred).[21]

For examination, the clinician does a general screen of the pelvis, abdomen and sacral nerves to check for signs of serious infection, inflammation or potential nerve damage.[21] For stress incontinence specifically, the examiner will ask the patient to cough (both in supine and in standing) and then assess for urine leakage that may occur.[21] The standing cough test has found to have a 91% positive predictive value for having SUI, but only a 55% PPV for having pure SUI only.[24] Patients who have completed voided prior to examination and exhibit urine leakage with the cough test examination may have more severe SUI and may require more invasive methods (such as surgery) to address the condition.[5,21] The clinician will also assess the strength of the levator ani and surrounding pelvic floor muscles using the Modified Oxford Scale for Pelvic Floor Musculature. A test for uretheral hypermobility may be indicated as well to assess if the urethra is inherently not in the proper position to be supported by surrounding structures.

In order to have the appropriate treatment, the correct diagnosis needs to be made about the type of urinary incontinence that is occurring. Urge incontinence occurs when

there is urine leakage that occurs in conjunction with an urgent need to urinate and is primarily caused by improper detrusor muscle activation. In stress incontinence, there is typically no detrusor muscle action noticed with the increase in intra-abdominal pressure. Mixed incontinence is when the patient presents with symptoms of both stress and urge incontinence. Typically, a patient's subjective history, 24-hour bladder diary, and an internal/external examination can provide the necessary information to make the appropriate diagnosis. However, other urodynamic laboratory examinations such as urethral pressure profile, cystourethroscopy, or cystometry can provide further information if the diagnosis is unclear or if the patient is considering surgery.[21] A doctor may also consider the use of prescription medicine such as Duloxetine to help control symptoms and improve quality of life, but there are many harmful side effects (such as nausea) that may prevent the patient from adhering to this medication.[25]

Treatment Options

Once the diagnosis of SUI is made, the patient can be referred to a pelvic floor physical therapist for conservative treatment. The primary goal of treatment is to strengthen the pelvic floor musculature and promote coordination of muscles so that proper closing urethral pressure can be maintained to avoid bladder leakage. There are a variety of treatment options, but pelvic floor exercise training (PFET) has the strongest evidence for managing and curing SUI (both by subjective and objective measures).[3,11,26–30] Pelvic floor exercise training has been found to be very successful in strengthening the pelvic floor muscles (by increasing cross sectional area of voluntary fibers), increasing overall pelvic floor stiffness and tightening the endopelvic fascia which all lead to

supporting urethral closure in response to increased pressure.[3] These exercises (also known as Kegel exercises) can be taught using internal tactile feedback and instruction; the patient has to contract the pelvic floor muscle as one unit and hold for various time periods. The physical therapist can also progress the exercises by having the patient perform these exercises on an unstable surface, such as a Swiss ball (see Figure 9).[31] A common prescription is performing these exercises 15x for 3 times a day (holding each contraction for 2-4 seconds).[31]. Patient adherence to exercise is notably improved with supervision (i.e. attending physical therapy sessions) when compared to providing the patient an instructional pamphlet and greater adherence to PFET results in a better outcomes (i.e. decrease in leakage episodes).[26,32] In addition to muscular strengthening, patients are taught a "The Knack" technique; patients are instructed to lift and tighten the pelvic floor before and during exertional activities in order to increase urethral pressure and thus avoid leakage.[26,31]

For patients who may have difficulty correctly performing pelvic floor exercises, pelvic electrode biofeedback can be utilized so that the patient can visually understand the strength of their contraction and determine if they are using the correct muscles.[33] Another method of biofeedback for PFET can be performed through the use of vaginal cones, which are weighted balls that are placed in the vagina. These cones gradually increase in weight to allow for stronger contractions and patients are instructed to hold the cone in place for a certain period of time. A recent study found that these cones are just as effective as typical pelvic floor exercise training, and people may be less adherent to this type of exercise due to the extra step of having to implement the cones.[29]

Nonetheless, it may be a beneficial treatment option for a patient who cannot contract the pelvic floor muscles properly.

Transvaginal electrical stimulation (TVEMS) utilizes vaginal electrodes and electrical current to stimulate pelvic floor contraction.[34] It may also have an effect on the neural mechanism affecting bladder irritability. TVEMS (in conjunction with visual biofeedback) performed 20 minutes a day (independently by the patient) has been found to improve pelvic floor strength and decrease leakage after 8 weeks.[34] Surface electrical stimulation has been found to be equally effective as TVEMS and can be used on patients who may feel uncomfortable with transvaginal electrode placement.[35] However, the TVEMS treatment has not been found to be more effective that pelvic floor exercises and therefore should only be a component of a treatment plan.[36]

Pessaries are intra-vaginal rings that are used to support the urethra against the pubic symphysis and keep the proximal urethra and bladder neck elevated and supported during times of increased intra-abdominal pressure (see Figure 10). Pessaries are made of synthetic material and are individually sized and created for a patient by a gynecologist or urologist. Patients are typically able to self-manage pessary usage as long as they are cognizant enough to understand how to routinely clean the pessary and also be able to notice dangerous signs that require immediate attention, such as vaginal discharge or bleeding.[37,38] Pessaries have been found to be equally effective as pelvic exercises for controlling SUI leakage after 1 year and have a high patient satisfaction rate.[33] However, some patients may not feel comfortable using this device and therefore these rings should be considered for patients who were not successful with PFET or are high risk for surgery or injection therapy.

Collagen injection therapy is used to "bulk" up the supporting pelvic tissue around the urethra (see Figure 11).[39] It may be a necessary option for patients who may not be able to undergo surgery or have already been through surgery and continue to have SUI symptoms. It has been found to effective in the short term, but has decreased efficacy after one month and may require multiple treatments.[39] Stem cell injection therapy is another injection method that promotes increased muscular growth specifically to the voluntary external urethral sphincter musculature through stem cell differentiation. The growth factors in stem cells have also been found to improve the vascularity of the urethral submucosa layer which can also contribute to urethral closure pressure.[40] However, further research needs to be conducted about the appropriate dosage and location of injection to allow this type of therapy to become more commonplace.[41]

Surgery is typically considered the final option for patients with SUI who have undergone conservative treatment and not experienced success. There are many types of surgery options, such as colosuspension, vaginal anterior repair or use of synthetic tape. However, the most common type of surgery done is suburethral sling surgery. Biological or synthetic material can be used to create a "sling" that lifts the urethra and aids closure against increased bladder pressure (see Figure 12). With the traditional method, the sling is placed under the urethra and attaches to the rectus muscle/ileopectineal ligaments. In the minimally invasive method, synthetic tape that is covered in mesh is fixed around the mid-urethra to provide support. Both methods have been found to be equally effective in treating SUI (RR = 0.97 of having SUI symptoms after 1 year), but the minimally invasive method has shorter operative and recovery times and also has less reported adverse events.[42] Both surgeries were found to have subjective cure rates of 71-75% and

objective cure rates between 57 – 92% within one year and would be solid options for a patient with severe SUI to consider.[5,43]

Stress incontinence is a condition that has a large psychological and emotional impact on many women today. It is especially common in patients who are pregnant/have been pregnant and for those who participate in sports activities; populations that are commonly seen in a typical outpatient physical therapy practice. Treatment of this condition is straightforward and highly successful, but many women may be too embarrassed to bring up their condition to their healthcare provider. As therapists in any setting, we can screen for this condition, educate our patients about possible treatment options and discuss the effectiveness of these treatments. An appropriate referral to a specialized pelvic floor therapist or a patient's gynecologist would be warranted for a thorough examination and individualized treatment plan. By being aware of this diagnosis and potential treatment options, we can have a large impact on our female patients' quality of life and daily functioning.

Appendix

Figure 1 – Simplified Relationship of Bladder and Urethral Pressure Resulting in Leakage[44] – Ostergard et al., 2011

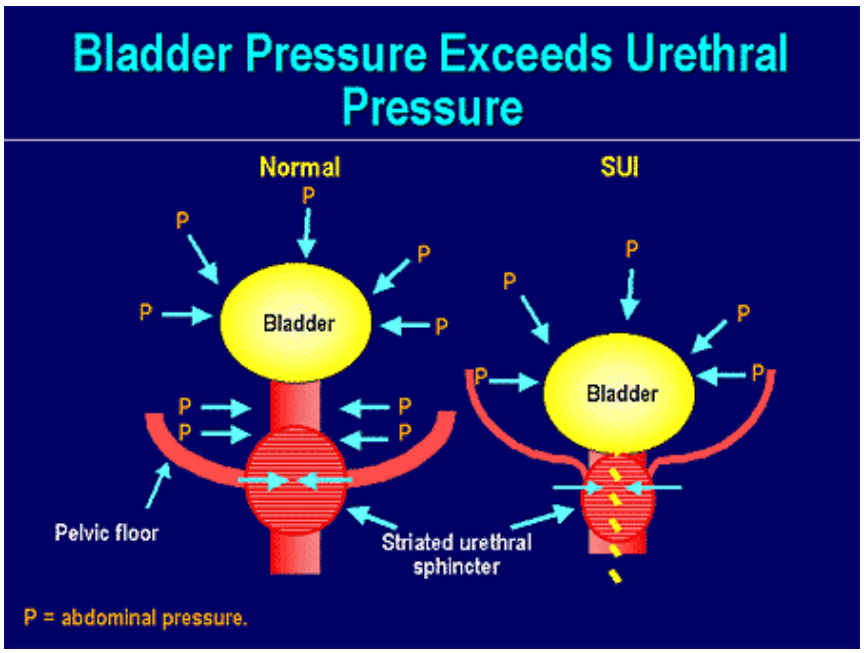


Figure 2 – Abdominal and Pelvic Cavities[31] – Ghaderi and Oskuei, 2014

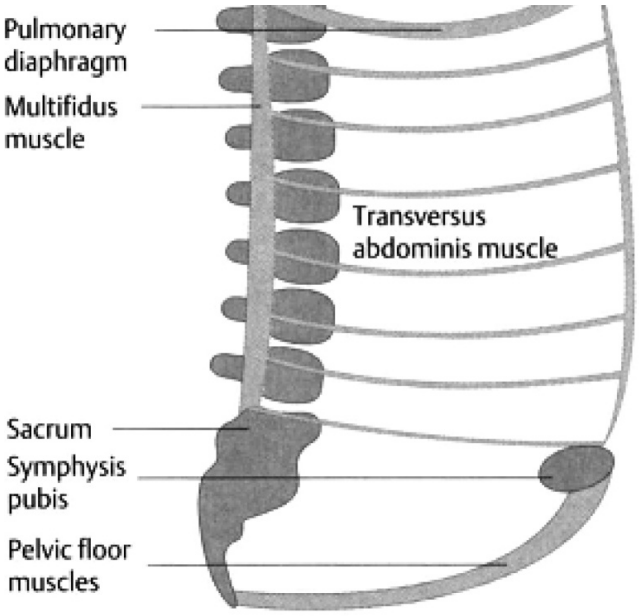


Figure 3 – Levator Ani and Coccygeus Muscles[45] – Herschorn, 2004

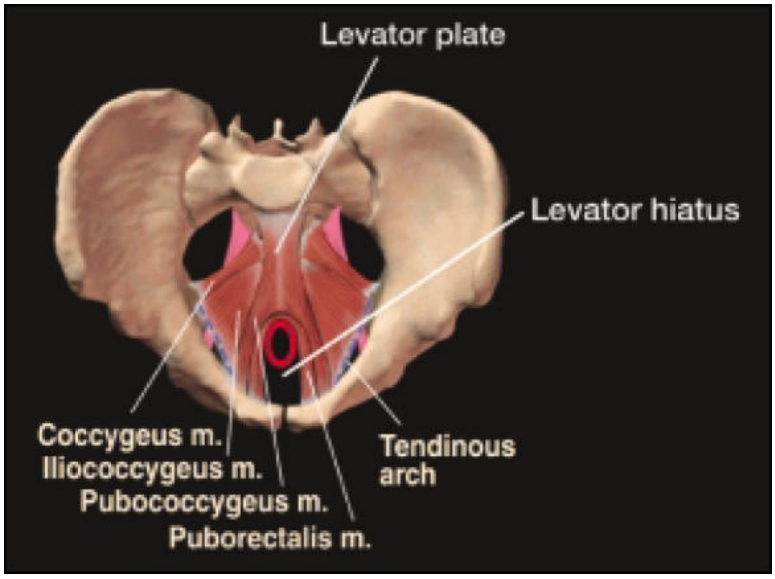


Figure 4 – Openings of the Levator Ani Muscle[6] – Gill et al., 2013

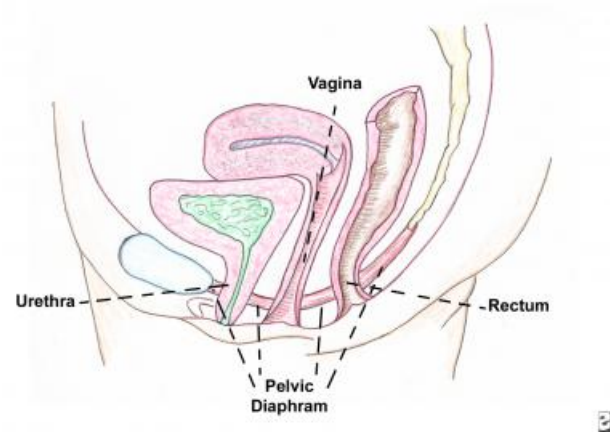


Figure 5 - General Bladder and Urethra Anatomy[6] – Gill et al., 2013

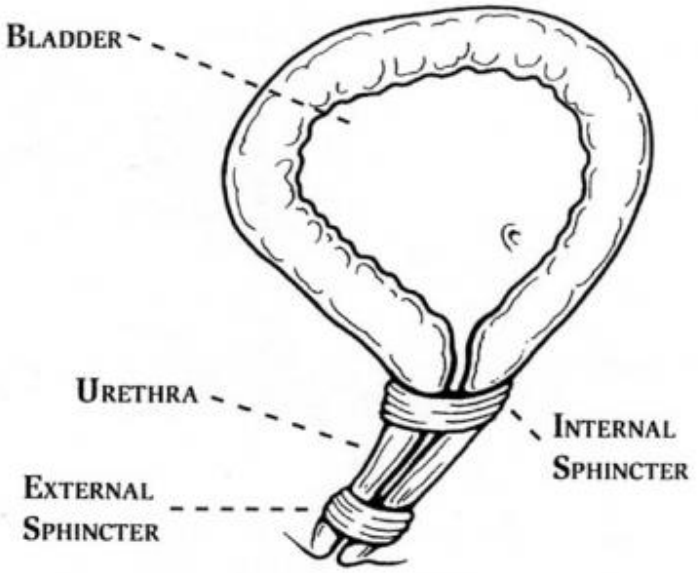


Figure 6 – Layers Surrounding the Urethral Opening[6] – Gill et al, 2013
Spongy coat contains vascular tissue that contributes to urethral closing pressure

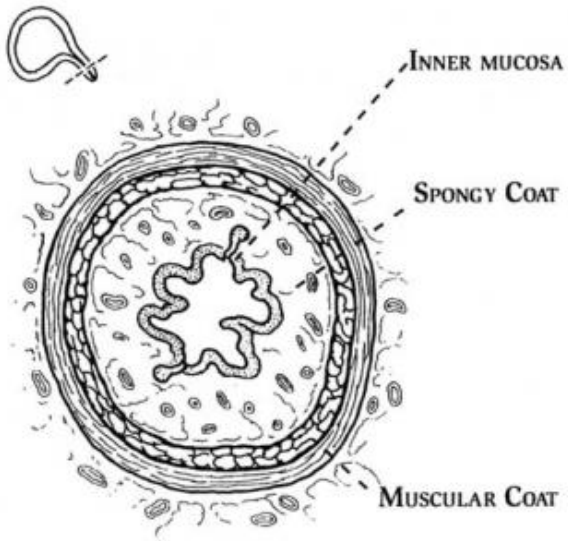


Figure 7 – Internal and External Urethral Spinchter[7] - Dwyer, 2004
Note: The rhabdospinchter is a voluntary, striated muscle typically considered part of the external mechanism and not internal as shown in this picture[6]

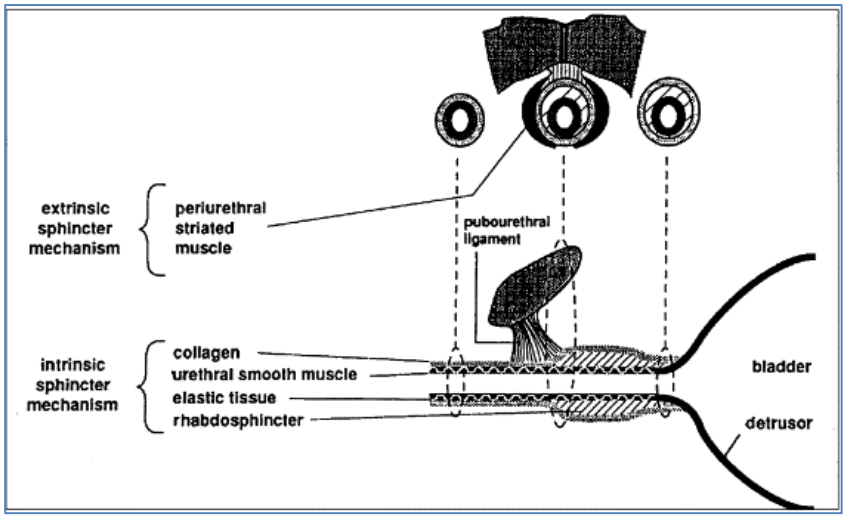


Figure 8 – Endopelvic Fascia Support for the Urethra ("Hammock Hypothesis")[8] – Delancey, 1991

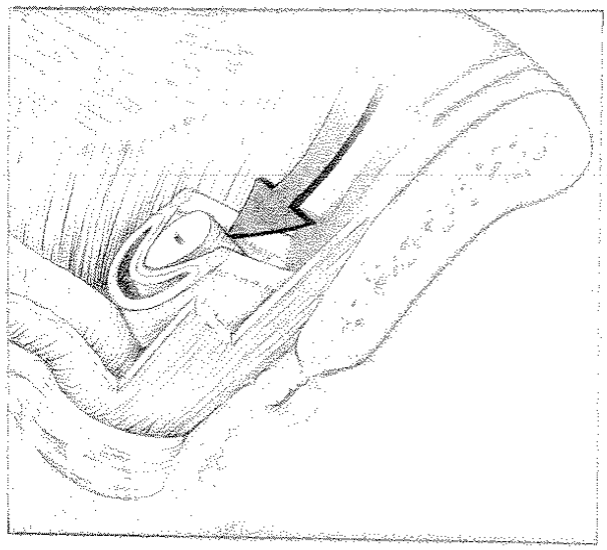


Fig. 6. Lateral view of pelvic floor with urethra, vagina, and fascial tissues transected at level of vesical neck drawn from three-dimensional reconstruction indicating compression of urethra by downward force *(arrow)* against supportive tissues indicating influence of abdominal pressure on urethra *(arrow)*.

Figure 9 – Progression of Pelvic Floor Exercises[31] – Ghadheri and Oskuei, 2014

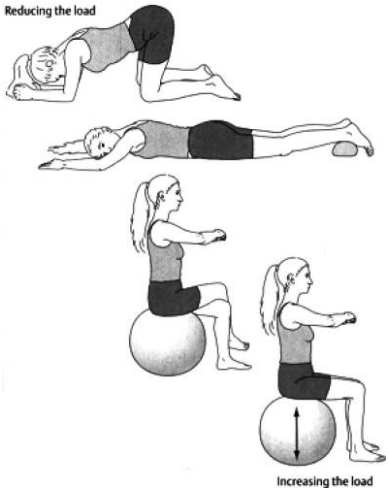


Figure 10 – Pessary Placement – Komaroff, 2013[46]

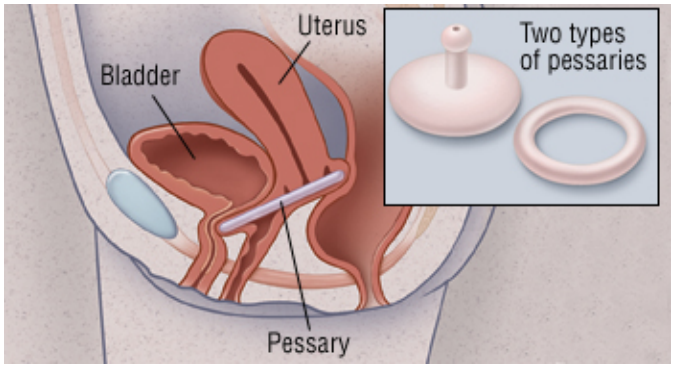


Figure 11 – Placement of Collagen Bulking Agent – Image from Web[47]

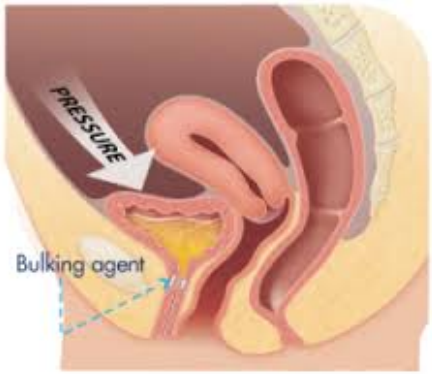
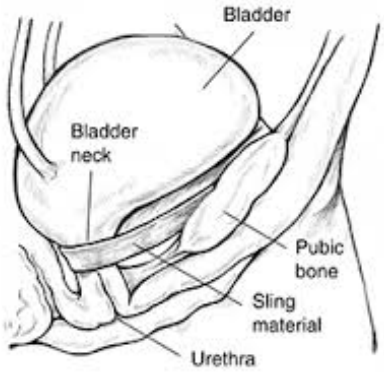


Figure 12 – Surgical Sling Placement[48] – Hinoul et al., 2011



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