Masaryk University

Faculty of Sports Studies

Department of Health Promotion

Fyzioterapie u pacientů s močovou inkontinencí

Physiotherapy in Patients with Urinary Incontinence

Bachelor thesis

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Physiotherapy

Brno, 2020

I hereby declare I wrote this thesis on my own with the supervision of Mgr. Michaela Bobrová, I have acknowledged all sources used and have cited these in the reference section.

In Brno .....

Signature

I would like to thank my supervisor Mgr. Michaela Bobrová for her guidance, encouragement, support and valuable comments. My sincere thanks also go to the patient who allowed me to do the therapy of such a sensitive subject.

Bibliografical identification

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Annotation:

In the bachelor thesis, I deal with the effect of physiotherapy in young female athlete suffering urinary incontinence. The thesis is split into theoretical and practical parts. Firstly, theoretical knowledge about the given issues is described. Then the practical part deals with the description of the therapies and appraisal of its effect.

Keywords: athlete, female, pelvic floor, physiotherapy, rehabilitation, urinary incontinence

Content

LIST OF ABBREVIATIONS

CNS	Central nervous system
DNS	Dynamic Neuromuscular Stabilization
ICQ-UI SF	International Consultation on Incontinence Questionnaire - Urinary Incontinence Short Form
ICS	International Continence Society
ISSS	Integrated spinal stabilizing system
MUI	Mixed urinary incontinence
OAB	Overactive bladder
OAB-q	Overactive Bladder Questionnaire
PAG	Periaqueductal gray
PFM	Pelvic floor muscles
PFMT	Pelvic floor muscle training
PMC	Pontine micturition center
SUI	Stress urinary incontinence
UI	Urinary incontinence
UUI	Urgency urinary incontinence

INTRODUCTION

As the topic of my thesis, I have chosen “Physiotherapy in Patients with Urinary Incontinence”. I opt for this issue for several reasons.

First of them is that urinary incontinence is a fairly frequent phenomenon but still remains a taboo subject. In some sports, such as basketball, gymnastics or volleyball, the incidence of urinary incontinence is more than 40 % among young female athletes (De Mattos Lourenco et al., 2018). According to the current guidelines, conservative nonpharmacological therapy is the first-choice treatment and physiotherapy has an irreplaceable role in it (Holaňová & Krhut, 2010).

There are several concepts specialized in urinary incontinence or pelvic floor dysfunction that can be used as a form of physiotherapy. Among the Czech approaches belongs, for example, The Mojzis Method and The Ostrava Concept, from the foreign methods, Kegel's exercise will be described. Of these concepts, The Mojzis method was used in our therapies.

If urinary incontinence is left untreated, it "can have a significant negative impact on a woman's physical, social, economic, and psychological well-being" (Goforth et al., 2016, p. 423) as well as decrease the quality of life (Muth, 2017). In many cases, physiotherapy can significantly eliminate urinary leakage. The only disadvantage is a long period of therapeutic care. The first positive results can be recorded after two months. However, the maximal therapeutic effect is reached after half a year (Holaňová & Krhut, 2010).

This bachelor thesis is focused on a case study of an 18 years old nulliparous female athlete. The therapies conducted for five months from November 2019 to March 2020 and afterward, the therapeutic effect was assessed.

1 ANATOMY AND PHYSIOLOGY OF FEMALE PELVIC FLOOR AND LOWER URINARY TRACT

The main function of the lower urinary tract is to store and to periodically dispose of urine. This is possible due to the cooperation of the two units, the urinary bladder as storage and urethra, urethral sphincter and pelvic floor as an outlet (De Groat & Yoshimuray, 2015).

The correct function of the lower urinary tract is conditioned by the optimal support of both surrounding passive and active tissues. Moored boat analogy of the support system is demonstrated by figure 1 and described in more detail in the following chapters (Bansal, 2013).

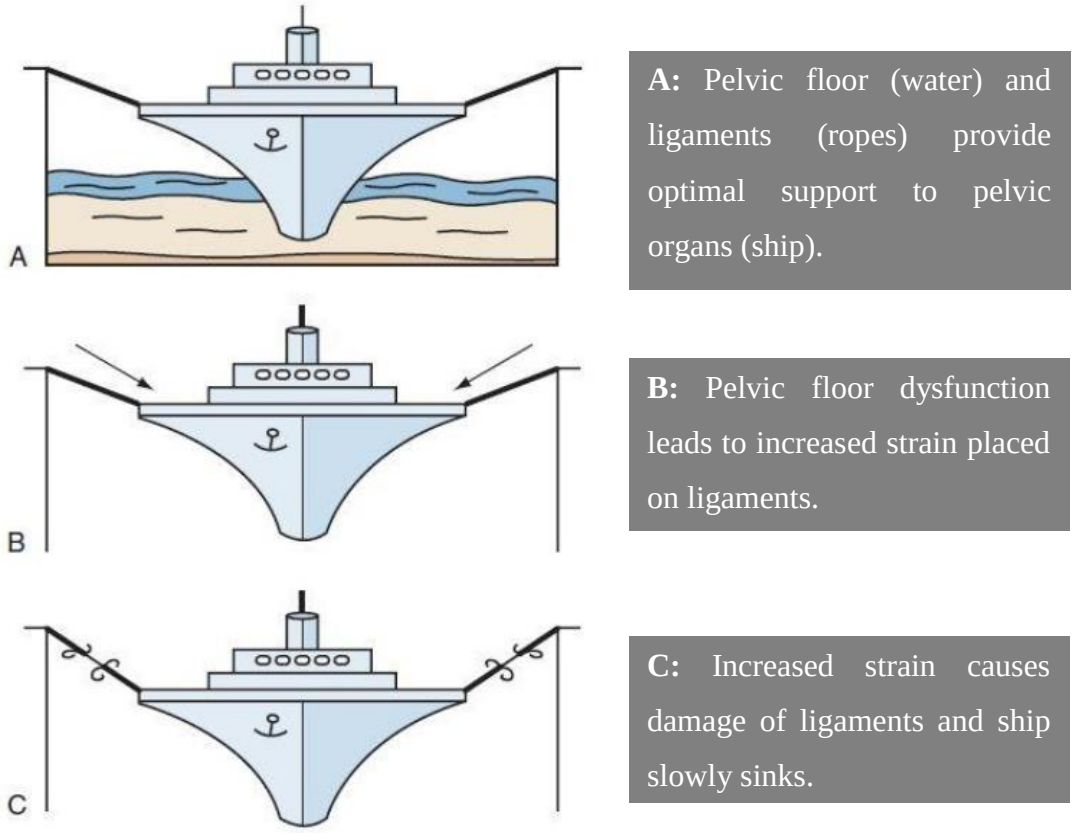

Figure 1: Pelvic floor support mechanism (Bansal, 2013)

1.1 Passive Structures

The pelvis is a base of the spine, with os sacrum being the center of the base. Passive pelvic structures include ligaments, bones and fascias. Their main functions are to protect and provide optimal support to the pelvic organs and transfer trunk weight to the

lower half of the body through the sacroiliac and hip joints (Siccardi & Valle, 2019; Rocca Rossetti, 2016).

“Urethra, vagina and rectum are kept in place and in certain sense supported by pubosacral ligaments to which they adhere through connections called from time to time pubo-urethral, pubo-vaginal, pubo-rectal, sacrorectal ligaments” (Rocca Rossetti, 2016, p. 33)

1.1.1 Bones

Bony pelvic is a funnel-shaped structure inferiorly closed with membrana perinei, serving as an attachment of the pelvic floor soft tissues (muscles, ligaments, and fascia). It is composed of two congruent bones made from the os ilium, os ischii (ischium) and os pubis (pubic bone), which are fused to each other anteriorly and to os sacrum posteriorly. On the sacrum caudally mounts os coccyx. The position of each bone is shown in figure 2 (Eickmeyer, 2017; Rocca Rossetti, 2016).

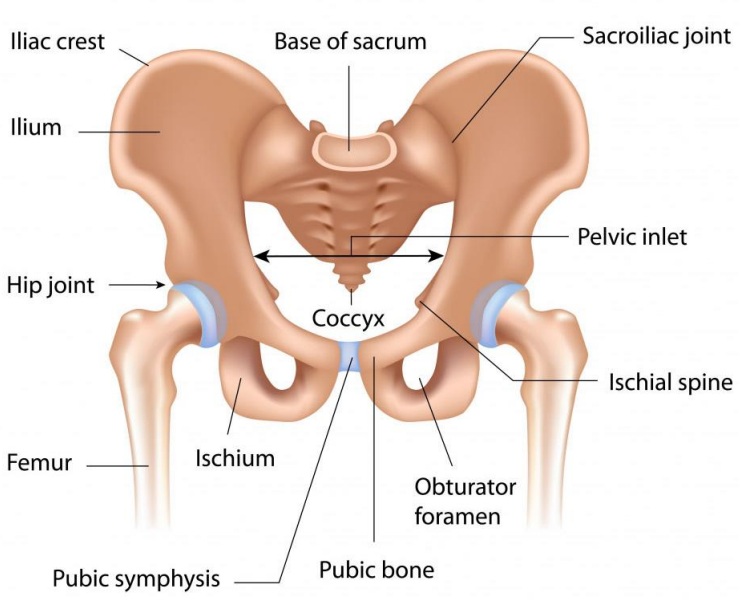

Figure 2: Pelvic girdle skeleton anatomy (Pelvic Girdle Skeleton Anatomy, 2019)

The female bony pelvis has a wider diameter than the male one, which itself results in a predisposition to more frequent pelvic floor muscle weakness (Herschorn, 2004).

1.1.2 Fascias

Fascia is a network formed of soft connective tissue. There are two fascias in the area of the lesser pelvis, fascia pelvis parietalis and fascia pelvis visceralis (Benjamin, 2009).

1.1.2.1 Fascia Pelvis Parietalis

Fascia pelvis parietalis covers striated muscles of the lesser pelvis, such as m. obturatorius internus, m. piriformis and m. levator ani (Otčenášek, 2017).

1.1.2.2 Fascia Pelvis Visceralis

Fascia pelvis visceralis, also called endopelvic fascia "forms one continuous unit composed of collagen, elastin and nonvascular smooth muscle fibers and is penetrated by blood and lymph vessels and nerves" (Otčenášek et al., 2008, p. 622).

It creates a septum surrounding the vagina and uterine cervix and divides the pelvic floor into the anterior and posterior parts. In the front, it inserts into the body of os pubis. In the back, it converts into membrana perinei and in the sides, it attaches to the superior fascia of the m. levator ani. The upper edge of that attachment is called arcus tendineus fasciae pelvis. Described structures are shown in figure 3 (Otčenášek, 2017; Otčenášek et al., 2008).

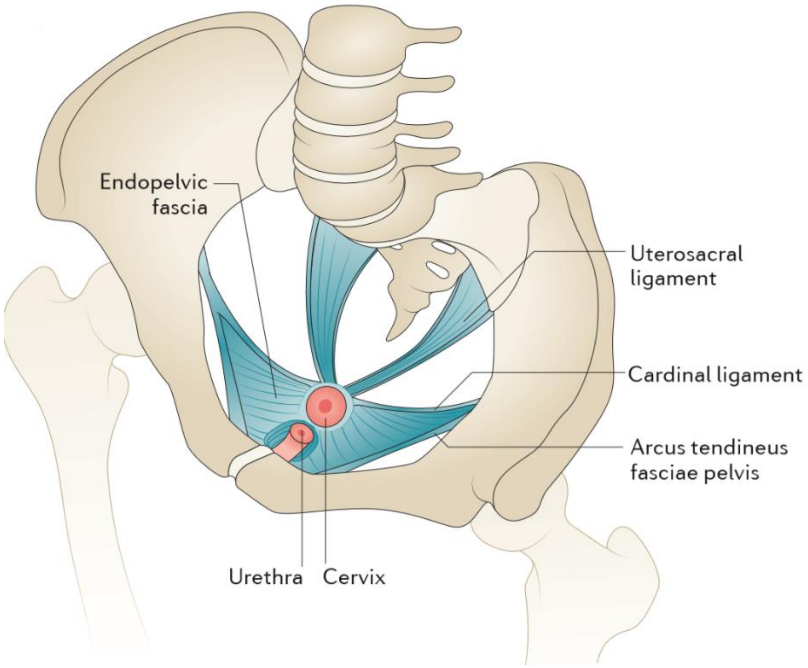

Figure 3: Fascia pelvis parietalis (Aoki et al., 2017)

1.2 Active Structures

Active structures are composed of muscles of the pelvic floor formed by two larger units, diaphragma pelvis and membrana perinei. Their task is to “shrivel, relax, synergize, antagonize, stabilize (…) according to pelvic organs activity (filling, voiding) or resting” (Rocca Rossetti, 2016, p. 29). They engage in the postural, sphincter, and

sexual function, support pelvic organs and help to maintain optimal intra-abdominal pressure. In the area of the lesser pelvis are also located muscles involved in hip rotation, such as m. piriformis and m.obturatorius internus. Location of the muscles mentioned above is shown in figure 4 (Otčenášek, 2017; Prokešová, 2017).

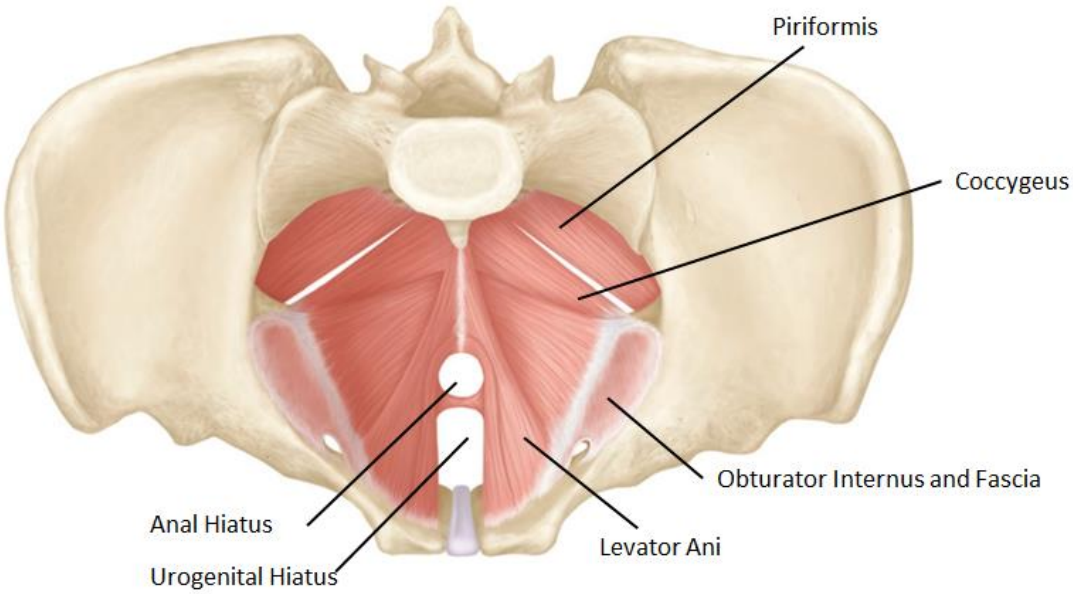

Figure 4: Pelvic floor muscles, superior view (The pelvic floor and pelvic contents, 2019)

1.2.1 Diaphragma Pelvis

Pelvic diaphragm (diaphragma pelvis) is a bowl shape muscle structure composed of the musculus levator ani and musculus coccygeus. Its role is to support the viscera, maintain optimal intra-abdominal pressure and continence. The position of diaphragma pelvis is represented in figure 5 (Otčenášek, 2017).

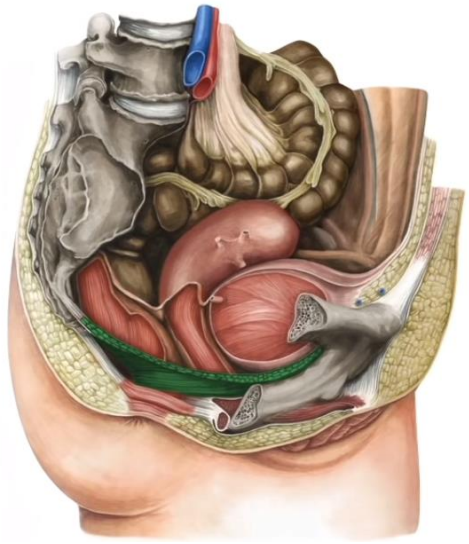

Figure 5: Lateral view of diphragma pelvis (green) (Muscles of the pelvic floor, 2019)

1.2.1.1 M. Levator Ani

M. levator ani is composed of three sets of fibers – m. ischiococcygeus, m. iliococcygeus and m. puborectalis. They all originate from the posterior part of os pubis and from the tendinous arch by fascia of m. obturatorius internus all the way to spina ischiadica. It inserts in coccyx and in the midline called ligamentum anococcygeum. The nomenclature of its parts is inconsistent, so we can also come across names such as m. pubovaginalis, m. puboureteralis, m. pubosacaralis, m. pubococcygeus, etc. (Otčenášek, 2017; Prokešová, 2017).

Main function of m. levator ani is to support pelvic organs, to elevate pelvic floor, keeps rectum and vagina closed, resists intrapelvic pressure during physical activity, coughing or sneezing when intraabdominal pressure rises and prevent the evacuation of the content of the gastrointestinal tract (Chaitow & DeLany, 2011).

The vagina, rectum and urethra go through the hiatus rectalis and urogenitalis in m. levator ani. During contraction, levator pushes the organs towards the os pubis by reducing the size of the hiatus. Therefore, the prolapse of pelvic organs is often associated with m. levator ani defects, as evidenced by a study of Beger et al. (2014) in which 70% of patients with the prolapse is explained by m. levator ani defects (Arenholt et al., 2017).

M. puborectalis keeps the rectal angle, which prevents filling the anal canal with feces from rectum. When relaxed, the angle increases and feces can flow to the anal canal and leads to defecation (Chaitow & DeLany, 2011).

1.2.1.2 M. Coccygeus

M. coccygeus (m. ischiococcygeus, m. iliococcygeus) lies over ligamentum sacrospinale and it forms the posterior part of diaphragma pelvis. It originates on spina ischiadica and inserts to lateral parts of os coccygeus and vertebra S5. It cooperates with m. levator ani, stabilizes the sacroiliac joint and allows coccyx flection (Chaitow & DeLany, 2011; Kachlík, 2019).

1.2.2 Membrana Perinei

Membrana perinei (membrana urogenitale, diaphragma urogenitale, perineal membrane) is a triangle-shaped soft tissue made of collagen and both striated and smooth muscle fibers. It lies below diaphragma pelvis and stretches between corpus and rami of os pubis. From above fascia pelvis visceralis converts in the membrana perinei (Otčenášek, 2017; Rocca Rossetti, 2016).

In the front, it lets urethra and vagina pass and fills the space where two levators ani don't join each other. The area in the back behind the vagina is called centrum tendineum perinei or perineal body, into which m. sphincter ani externus attaches, as shown in figure 6 (Otčenášek, 2017; Rocca Rossetti, 2016).

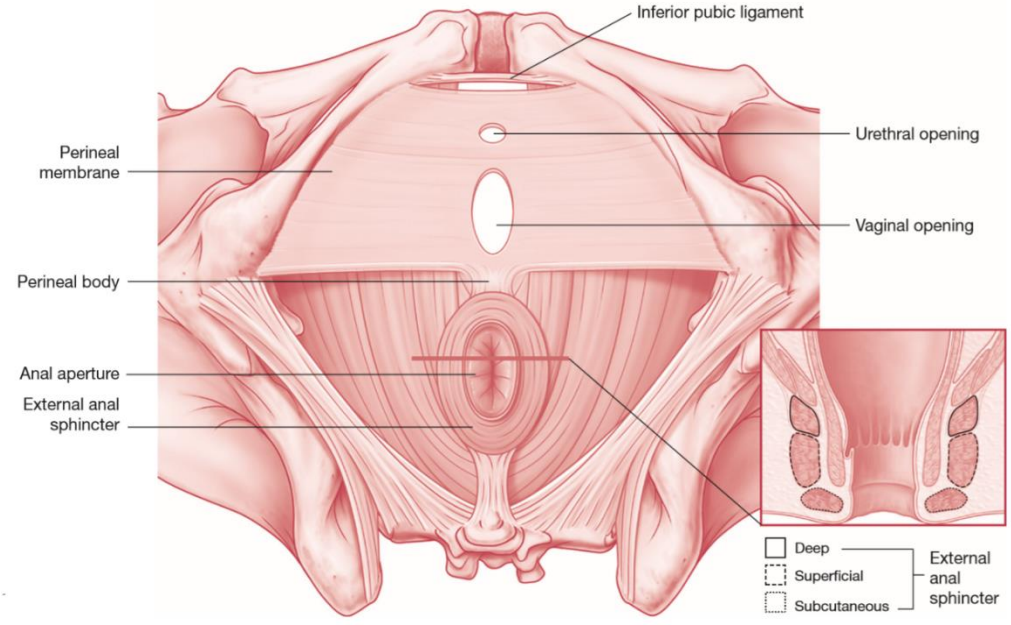

Figure 6: Membrana perinei (Chaitow & DeLany, 2011)

Membrana perinei is in some nomenclature divided into individual thin muscles, m. transversus perinei profundus, which fix centrum tendieum perinei, and m. sphincter urehtrae externus closing the urethra (Prokešová, 2017).

1.2.2.1 Deep Perineal Pouch

"Although generally the pelvic cup closure is described as three superimposed layers, pelvic diaphragm, urogenital diaphragm and perineum, (…) this division results quite artificial (…) it is impossible not to include the urogenital diaphragm in the perineum" (Rocca Rossetti, 2016, p. 32). Therefore, the subchapter about the deep perineal pouch is included in this section. The muscles of the perineum is the most superficial layer of the pelvic floor and they are represented by figure 7 and 8.

Among muscles of perineum belongs:

- m. compressor urethrae: compresses urethra
- m. sphincter urethrovaginalis
- m. ischiocavernosus
- m. bulbocavernosus: increases the venous filling of the clitoris and evacuates the filling of glandulae vestibulares
- m. transversus perinei superficialis (Prokešová, 2017).

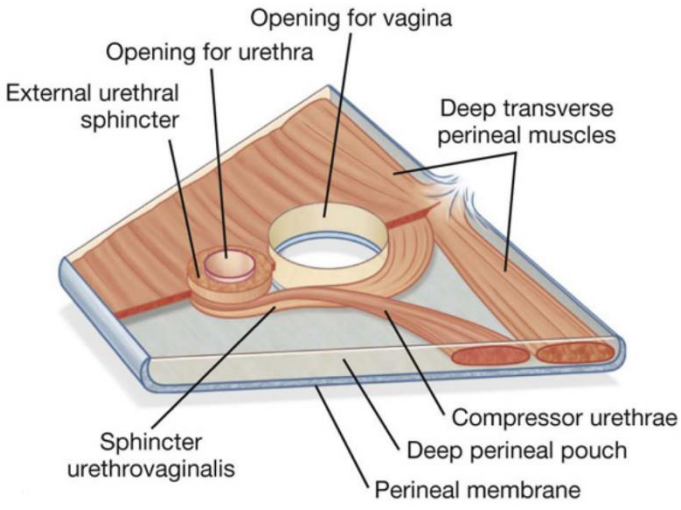

Figure 7: Muscles in the deep perineal pouch in women (Pelvis and Perineum, 2016)

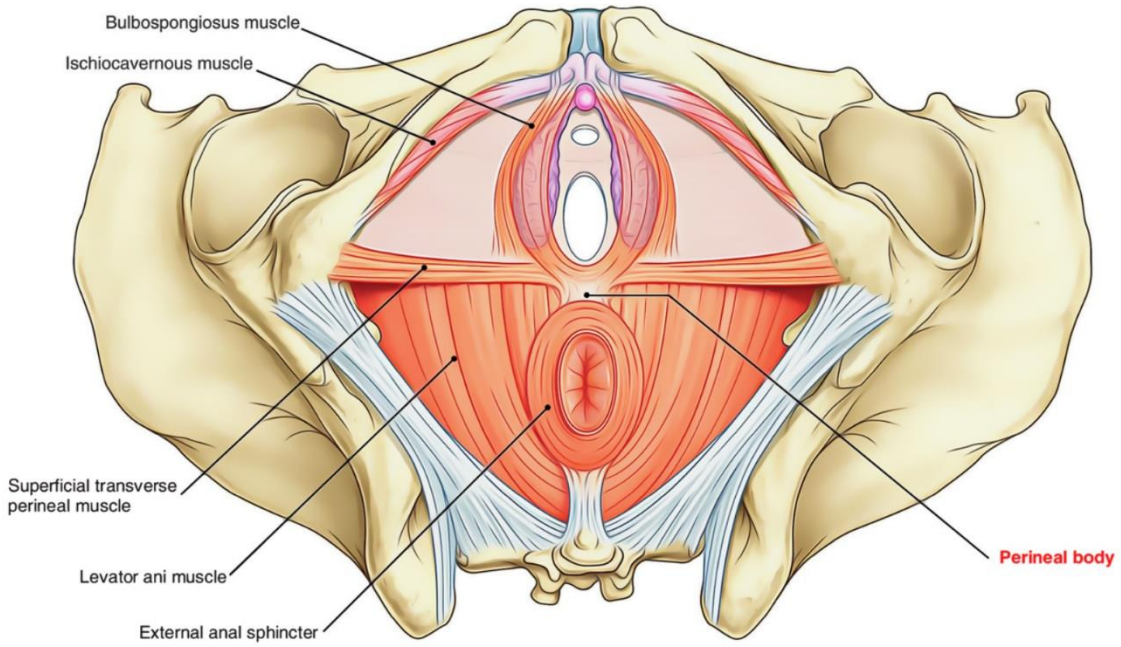

Figure 8: Muscles in the deep perineal pouch, inferior view (Volker, 2018)

1.3 Pelvic Organs

In the area of the lesser pelvis are located some urogenital and gastrointestinal organs, such as urinary bladder, urethra, vagina, uterus and rectum.

1.3.1 Urinary Bladder

Urinary bladder (vesica urinaria) is an elastic sac, storing urine to be voided, with an average comfortable capacity of 400 – 600 ml. Urine is brought from the kidneys via ureters, collected in the bladder and is expelled through the urethra (Ferng, 2019).

The bladder wall is composed of the inner epithelium and outer muscle layer. The muscle layer is formed by detrusor muscle (m. detrusor vesicae urinariae), made of predominantly thick smooth muscle fibers. When the bladder expands and reaches near its peak capacity, the signals conducted by the parasympathetic nervous system contract the detrusor muscle (Aoki et al., 2017; Ferng, 2019).

The lumen of the bladder is internally lined with a high elastic transitional epithelium called urothelium, which also permeates into the urethra. The anatomy of the female bladder is represented by figure 9 and its position in the pelvis by figure 10 (Aoki et al., 2017; Ferng, 2019).

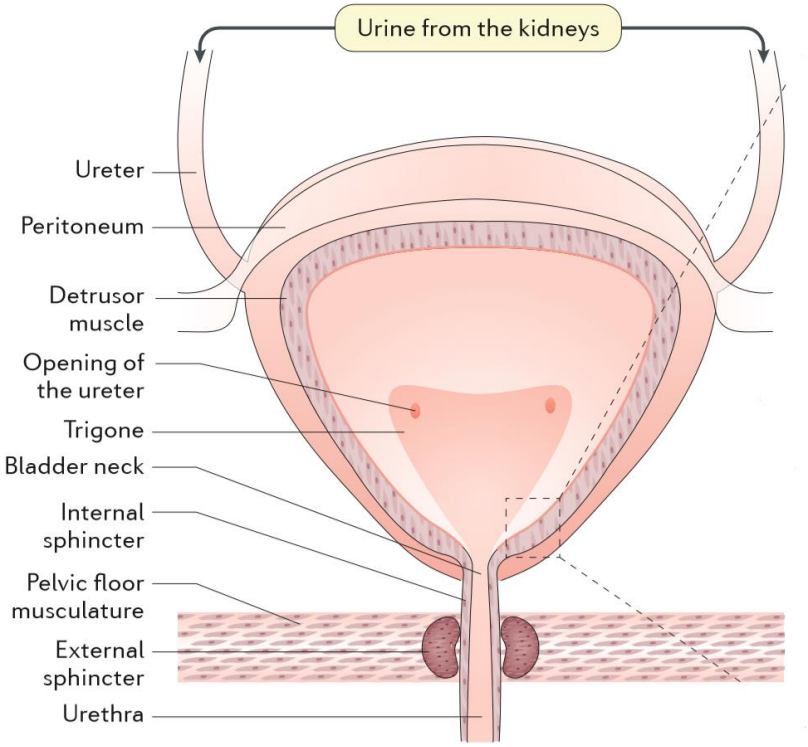

Figure 9: Anatomy and histology of the female bladder (Aoki et al., 2017)

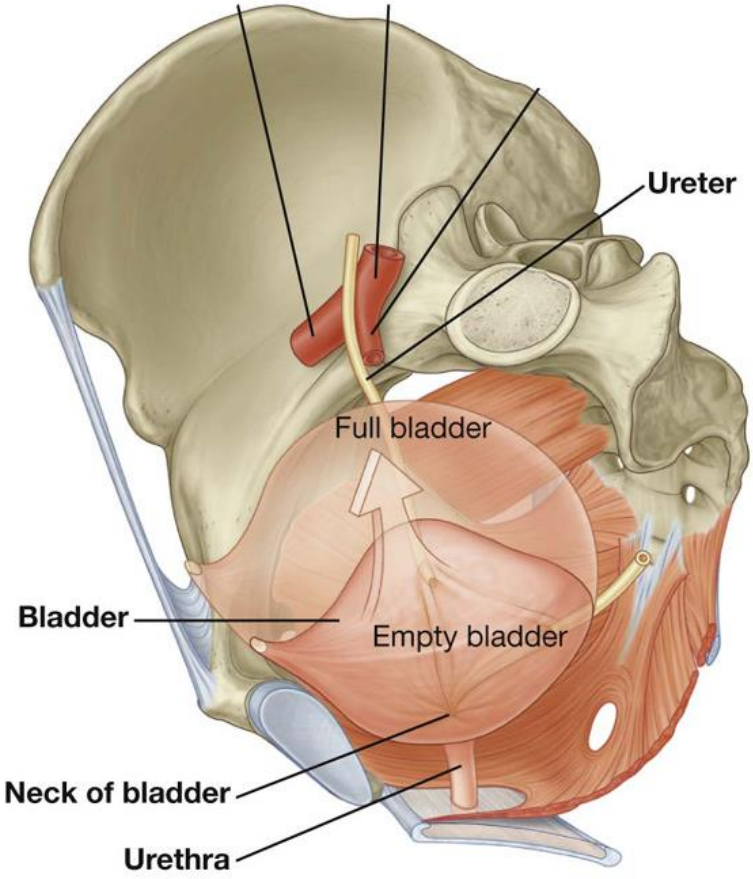

Figure 10: Position of urinary bladder (Volker, 2018)

1.3.2 Urethra

The urethra is an excretory duct emerging from the bladder expelling urine out of the body. The length of the female urethra is about 2.5 - 4 cm, width is 6 mm (Aoki et al., 2017).

Two muscle layers are found in urethra, comprised of the internal and external sphincter. The internal sphincter (m. sphincter urethrae internus) is found in the proximal third of the urethra. It contains two smooth muscle layers, inner longitudinal and outer circular, uncontrollable by will.

The external sphincter (m. sphincter uretrae externus, rhabdosphincter) is formed by the skeletal muscles of the pelvic floor (membrana perinei), therefore it is under voluntary control. It may be found at the interface of the middle and distal third of the urethra, as shown in figure 7 (Aoki et al., 2017; Fritsch et al., 2006).

„Urethral sphincteric mechanisms maintains urethral closure pressure above bladder pressure“(Ashton-Miller & DeLancey, 2007, p. 266) to control continence.

1.3.2.1 Urethral Support

Optimal position of urethra both at rest and during increased intra-abdominal pressure plays a key role in maintaining urinary continence. The main structures supporting the urethra and therefore keeping it in place include the anterior vagina, fascia pelvis parietalis and visceralis, and m. levator ani (Prokešová, 2017).

DeLancey's Hammock hypothesis presumes the vaginal-wall contribute to proper detrusor function by supporting the urethra. When intra-abdominal pressure increases, optimal support makes pressure transmission to both the bladder and urethra possible. If the support is insufficient, inadequate pressure distribution may lead to stress urinary incontinence. Figure 11 represents both optimal (A) and insufficient (B) urethra support (DeLancey, 1994; Kalejaiye et al., 2015).

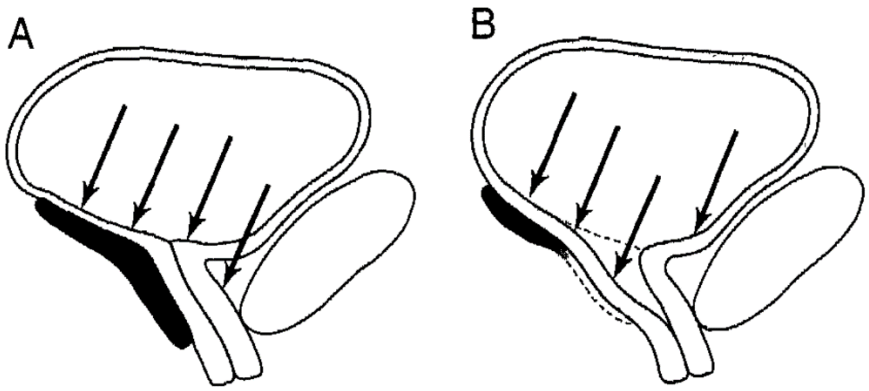

Figure 11: Effect of abdominal pressure on urethra depending on stability of the supportive layer (DeLancey, 1994)

“Normal function of the urethral support system requires the contraction of the levator ani muscle, which supports the urethra through the fascia (…). This levator ani contraction helps to tense the suburethral fascial layer and thereby enhance urethral compression” (Ashton-Miller et al., 2005, p. 3). An optimal pelvic muscle tone is crucial to release the tension upon the fascia. If the muscles atrophy, the ligaments would stretch under the constant load and urethra would have no support (Ashton-Miller et al., 2005).

1.3.3 Vagina

The vagina is a 7 - 10 cm long tube in the female reproductive system. It is located between the urethra and the rectum, extending from the vulva to the cervix uteri. “The vaginal canal has an outer fibrous adventitia, a middle layer of smooth muscle cells, and an inner layer of mucosa” (Gold, 2019, p. 1). Its main functions include menstruation, immune defense, reproduction and sexual function.

“In 1992, DeLancey described that the vagina could be divided into three levels based on cadaver dissection. Level I designates the cephalic 2–3 cm of the vagina, which is supported by the uterosacral and cardinal ligaments through their attachments to the cervix and upper vagina. At Level II, the pubocervical fascia and the vagina are attached to the ATFP (arcus tendineus fascia pelvis, A/N). The vagina is more fixed at this level (…). Level III is the caudal 2–3 cm above the hymeneal ring, where the vagina is fused with the surrounding structures—namely, urethra, perineal membrane, and levator ani“ (Arenholt et al., 2017, p. 661). The levels are represented by figure 12 and 13.

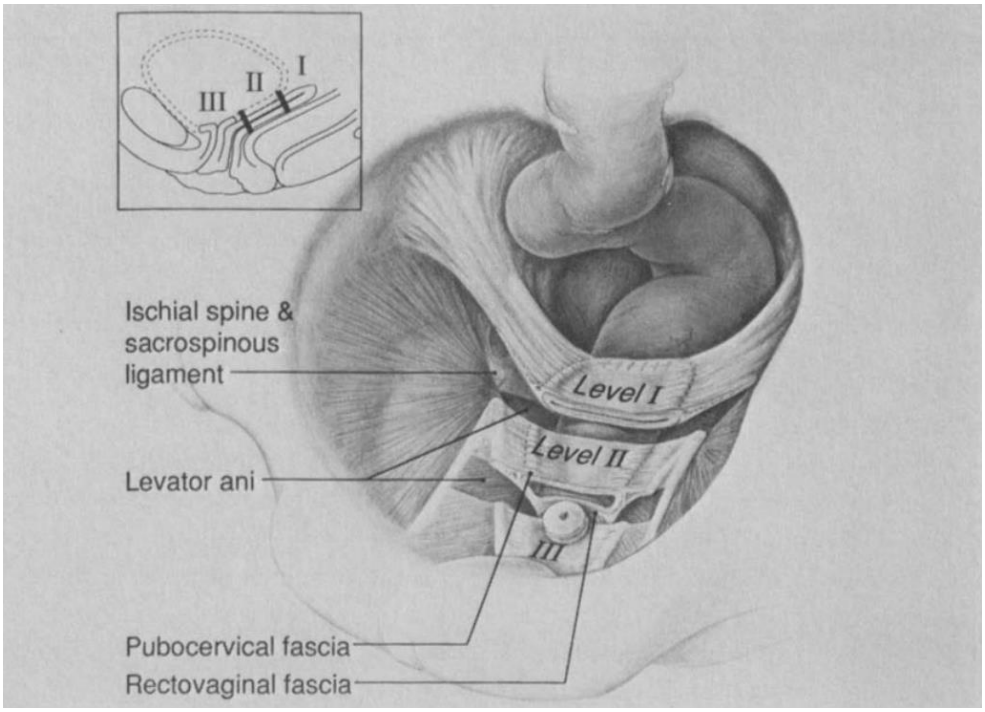

Figure 12: Division of vagina and its support system (DeLancey, 1992)

Arcus tendinous fascia pelvis is the main support structure of the vaginal anterior wall and protects it from descending and possible prolapse. Its origin is 2 – 3 cm lateral to the os pubis, overlays m. levator ani and attaches to the spina ischiadicia (Arenholt et al., 2017)

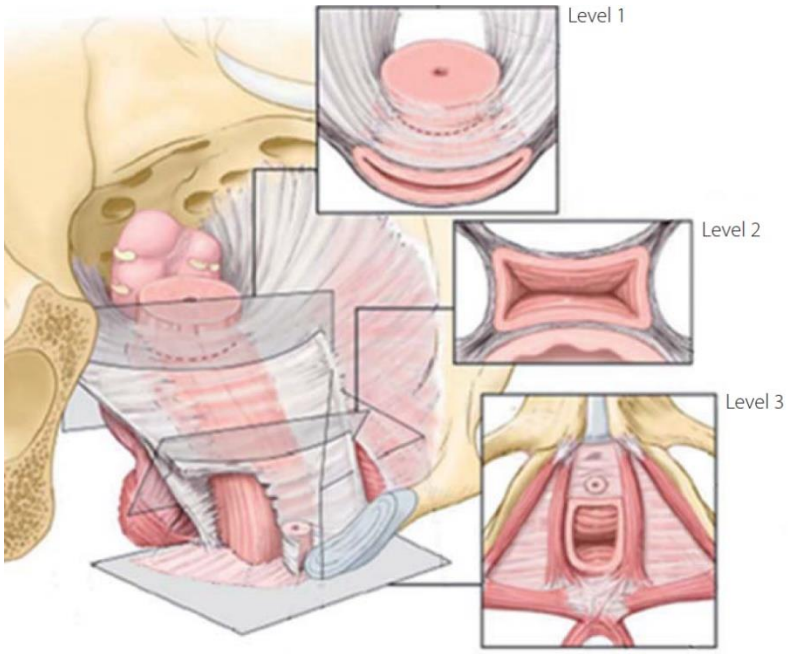

Figure 13: Vaginal support layers (Krhovský, 2011)

1.4 Nerve Supply

The area of the pelvic floor and lower urinary tract is innervated by sympathetic, parasympathetic and somatic nerve fibers.

Somatic nerve fiber is n. pudendus from plexus sacralis, spinal segments S2 – S4. It is the motor neuron of the striated pelvic floor muscles and innervates m. levator ani, m. coccygeus, muscles of the perineum, m. sphincter ani externus and m. sphincter urethrae externus. (Havlíčková, 2017). The motor cortex is not able to activate these muscles separately, therefore they always activate as one unit (Holstege, 2016).

The parasympathetic system innervates with nn. pelvici from spinal segments S2 – S4. The sympathetic pathway is represented by n. hypogastricus, from spinal segments Th10 - L2. These fibers of the autonomic nervous system control the activity of pelvic viscera and m. sphincter urethrae internus. The nerve supply is represented by figure 14. (Holstege, 2005).

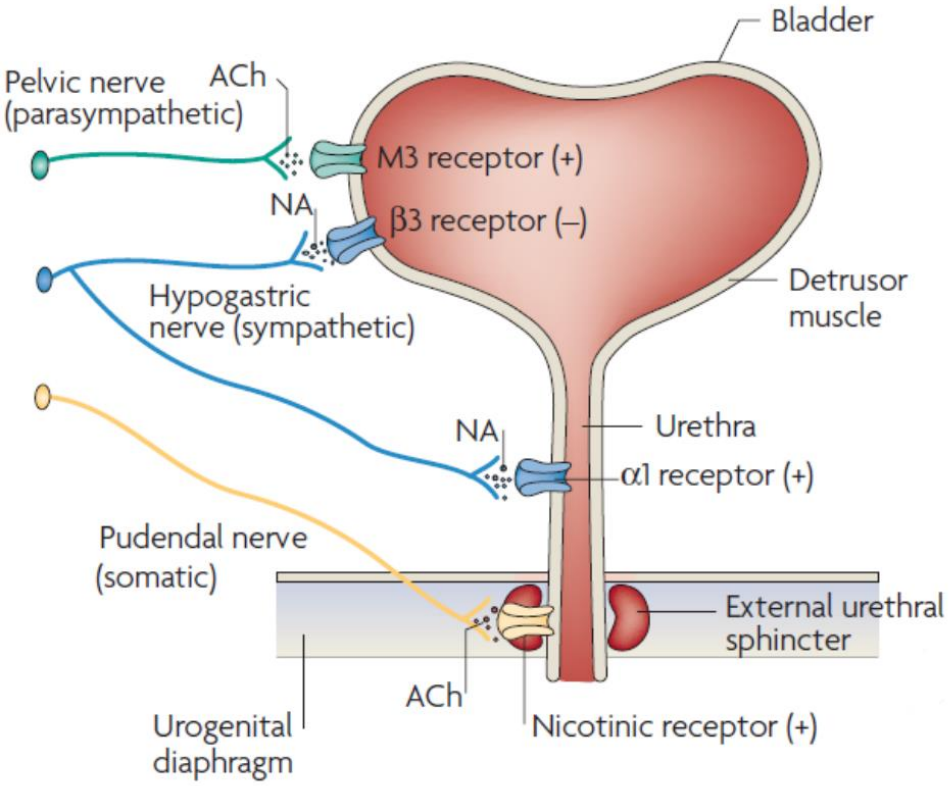

Figure 14: Efferent nerve supply of lower urinary tract and pelvic floor (De Groat & Yoshimuray, 2015)

During the bladder storage phase, mainly sympathetic pathway is active to keep the detrusor relaxed and m. sphincter ani internus contracted. On the other hand, parasympathetic supply is predominantly activated throughout the voiding phase contracting the detrusor. (De Groat & Yoshimuray, 2015; Holstege, 2005).

The voiding phase can start both voluntarily and involuntarily. “The former is readily demonstrated in the human infant when the volume of urine exceeds the micturition threshold. At this point, increased afferent firing from tension receptors in the bladder produces firing in the sacral parasympathetic pathways and inhibition of sympathetic and somatic pathways. The expulsion phase consists of an initial relaxation of the urethral sphincter followed by a contraction of the bladder, an increase in bladder pressure, and flow of urine” (De Groat & Yoshimuray, 2015, p. 74). The smooth muscle cells of detrusor have a tendency to contract when stretched beyond the threshold (Sugaya et al., 2005).

Sphincter and postural functions are closely linked. Sphincter functions mature after the development of upright bipedal walking and hip stabilization. Therefore voluntary sphincter control develops around two years of age and premature traumatic potty practice may evolve into pelvic floor dysfunction (Prokešová, 2017).

Due to the same spinal segment innervation of somatic nerves and sacral parasympathetic (S2 – S4) it is possible to influence the autonomic nervous system through the therapy of pelvic floor muscles. Removal of m. levator ani and m. coccygeus hyper tone reflexively relieves the spasm of smooth muscles of blood vessels, organs, and glands, thus improving perfusion of pelvic viscera. Spasm is caused by a higher rate of stress reactions overly activating sympathetic (Prokešová, 2017).

Afferent action is transferred to the central nervous system by A-delta and C nerve fibers. The fibers are located in serosa, the muscle layer, and urothelium of both the bladder and urethra. A-delta fibers are sensitive to bladder filling, C-fibers are activated by noxious stimuli or high-intensity irritation. (Reynolds et al., 2016; Sugaya et al., 2005).

1.4.1 Micturition Reflex Pathways

The micturition reflex has a center in pontine micturition center (PMC). Afferent fibers ascend to PMC. Efferent fibers run from PMC to inhibit the thoracolumbar sympathetic

and n. pudendus in order to relax both m. sphincter urehtrae externus and internus, and to stimulate sacral parasymapathetic, which allows starting voiding (Sugaya, 2005).

“There are both excitatory and inhibitory bladder-to-bladder, bladder-to-urethra, urethra-to-bladder, or urethra-to-urethra reflexes. When urine is being stored, these reflexes are set to promote storage. Some of the main switches for these reflexes are located in the pons, and some are in the spinal cord. The cerebral cortex exerts voluntary control and turns these switches on or off as needed” (Sugaya et al., 2005, p. 126).

Micturition reflexes are inhibited at many levels, including the cerebral cortex. Therefore voluntary voiding and continence are possible. Urine storage and voiding reflexes mechanism is represented by the figure 15. The figure does not show cognizant bladder sensations, nor the system shifting from storing to voluntary voiding. Both of these activities have a pathway through cerebral circuits above the periaqueductal gray (PAG) in the midbrain.

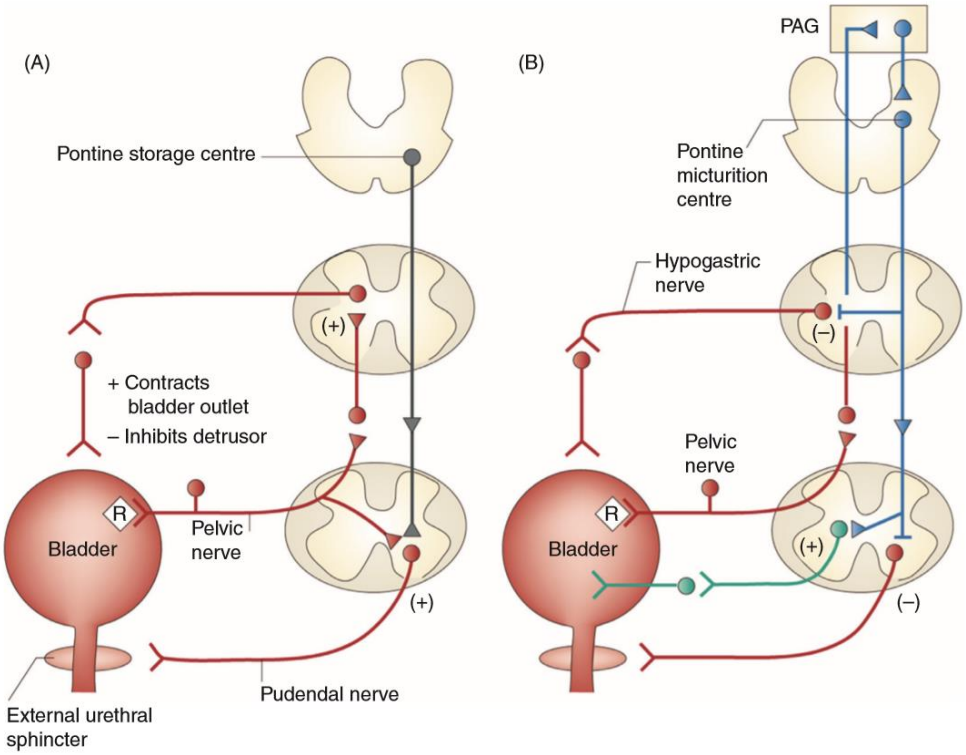

Figure 15: Neural circuits controlling continence and micturition (De Groat et al., 2014)

A: Urine storage reflexes

B: Voiding reflexes

As both sympathetic and parasympathetic nerve supply affect the function of the lower urinary tract, it is essential to keep the systems in balance to preserve optimal continence and voluntary voiding. Disbalance in these systems can lead to problems in the lower urinary tract, including incontinence (Pospíšil, 2019).

1.5 Viscero-Somatic, Viscero-Visceral & Somato-Visceral Convergence

Some of the somatic and visceral afferent neurons converge onto the same segment in the spine. Thus dysfunction in one location may change neuronal excitability in the spine and promote hypersensitivity or pain to regular sensation in other areas, which is analogously shown in figure 16 (Smith et al., 2009).

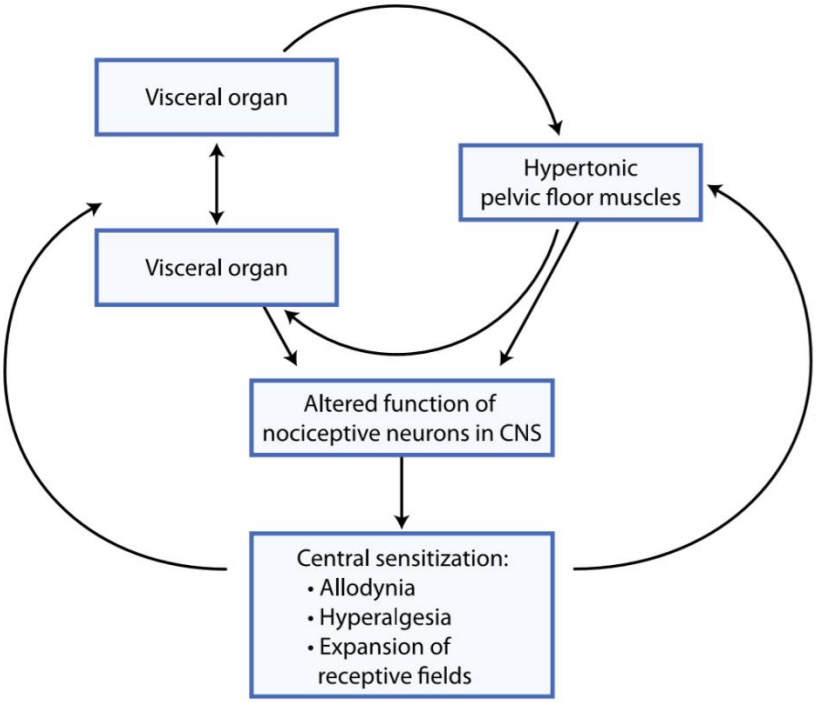

Figure 16: Connection of the viscera, pelvic floor, and the CNS (Hoffman, 2011)

CNS: Central nervous system

Because of the functional coordination of the viscera, one dysfunction is likely to manifest itself in another organ. Some patients with irritable bowel experiences incontinence, female with urinary tract troubles may have sexual dysfunctions (dyspareunia, decreased sexual arousal and activity). Animal study of Dmitrieva et al. (2001) revealed reduced uterine contractions while the urinary bladder inflammation in rats (Kaddumi & Hubscher, 2006).

Previous research of Peters et al. (2008) examined women with interstitial cystitis and have demonstrated that 93% of them also experienced pelvic pain, 52% constipation and 41% stress urinary incontinence.

Figure 16 also shows a possible pathway of influence between pelvic floor muscles and viscera. The mechanism can be both mechanical and via somato-visceral convergence. Nowadays, many visceral diseases (e.g., interstitial cystitis, endometriosis) confirm coexistence with hypertonic pelvic floor muscles (Hoffman, 2011).

According to Reynolds et al. (2016), viscero-somatic and somato-visceral convergence is one of the suspected causes of overactive bladder (described in more detail in chapter 2.1.2). Signals originating within the bladder can influence it via common afferent pathways.

"Visceral organ crosstalk involving the bladder is best described relative to activation of the bowel, which shares sensory innervation in regions of the thoracic and sacral spinal cord with the bladder" (Reynolds et al., 2016, p. 485). In several studies (Malykhina et al., 2006; Minagawa et al., 2013) rectal stimulation induce detrusor inhibition or overactivity as a result of the convergence of bladder and rectum C-fiber afferent nerves in the spine. The hypothesis of colon irritation contributing to incontinence or overactive bladder is represented by figure 17 (Reynolds et al., 2016).

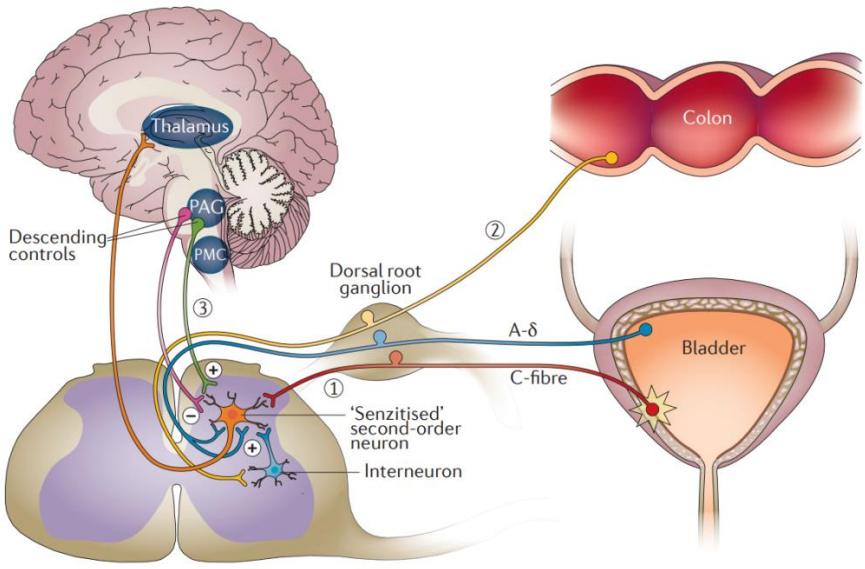

Figure 17: Cross-talk of colon and bladder (Reynolds et al., 2016)

PAG: periaqueductal gray

PMC: pontine micturition center

The study of Smith et al. (2009) states that women with incontinence or respiratory disease have a higher risk of developing back pain in the future. The trunk muscles, such as diaphragma, m. transversus abdominis and pelvic floor muscles, allow the proper function of the lower urinary tract, respiratory system and support the spine and the correct position of the pelvis. Therefore dysfunction of the trunk muscles will be reflected in all three areas. Changes in intra-abdominal pressure also influence the gastrointestinal tract and may lead to its disorder and vice versa.

1.6 Pelvic Floor Muscle Activity During Postural Changes and Physical Activity

Co-contraction of pelvic floor muscles and other trunk muscles is crucial to keep the continence while high-impact activities (e.g., sport, coughing, sneezing). A systematic review of Moser et al. (2017) showed that in continent women, pelvic floor muscles contracts before other trunk muscles during high-impact activities. In contrast, in incontinent women, they contract after the trunk muscles. Previous pelvic floor muscle activation is essential to increase urethral pressure prior to intra-abdominal pressure increase and therefore keep the continence.

Although delayed, while performing high-impact activities, incontinent women have a higher activity of pelvic floor muscles compared to continent ones. Deindl et al. (1994) have emphasized women experiencing stress incontinence have uncoordinated activation of m. levator ani, which may lead to dysfunctional actions.

The higher asymmetric activity of the pelvic floor can result in pelvic floor muscle having both hypertonic and hypotonic fibers. Inverted positions with a pelvis more elevated than the trunk (such as yoga pose sarvangasana) allow regeneration of the pelvic floor muscles from that pathological activation, as no continence or postural requirements apply at that moment (Pospíšil, 2019).

Posture seems to have no impact on proper muscle co-activation timing. However, the neutral position of the pelvis allows the stronger activity of pelvic floor muscles than while in a posterior or anterior pelvic tilt. As pelvic floor muscles both maintain continence and synergist in postural control, dysfunction in this system may manifest during the postural challenge. Significantly higher pelvic floor muscle activity is observed while standing in contrast to the supine position (Capson, 2011).

Women experiencing stress urinary incontinence dispose of higher trunk muscle activity in correlation with challenges to postural stability. “Increased activity of the pelvic floor and trunk muscles in women with stress urinary incontinence may impair balance as a result of a reduced contribution of trunk movement to postural correction or compromised proprioceptive acuity. Alternatively, distraction due to conscious effort to maintain continence may divert attention from the balance task” Smith et al., 2008, p. 77-78). Balance difficulties and pelvic floor dysfunction often occur together with insufficient foot support function and halluces valgi (Skalka, 2017).

2 URINARY INCONTINENCE

Urinary incontinence (UI) is defined as the chronic involuntary loss of urine. It can come as an outcome of a multitude of etiologies. If left untreated, it "can have a significant negative impact on a woman's physical, social, economic, and psychological well-being" (Goforth et al., 2016, p. 423) as well as decrease the quality of life (Muth, 2017).

2.1 Types of Chronic Urinary Incontinence

International Continence Society (ICS) divide incontinence into three basic types, which are stress urinary incontinence, urgency urinary incontinence and mixed urinary incontinence (Haylen et al., 2010).

2.1.1 Stress Urinary Incontinence

Stress urinary incontinence (SUI) is activity-related incontinence, characterized by an involuntary loss of urine on increased intra-abdominal pressure. Therefore, it typically occurs on coughing, sneezing, laughing or physical activity (especially jumping and heavy lifting). SUI is a cause of half of all urinary incontinence (Kalejaiye et al., 2015; Lim et al., 2016; Osman et al., 2016).

As a reflex reaction to increased intra-abdominal pressure, stronger contraction of bladder outlet occurs so urethra maintains closed. Intrinsic sphincter deficiency (ISD), poor pelvic floor activation and urethral hypermobility or malposition caused by weakness of supporting tissues may lead to SUI. The mechanism is represented by figure 18 (Delancey, 1994; Kalejaiye et al., 2015; Osman et al., 2016).

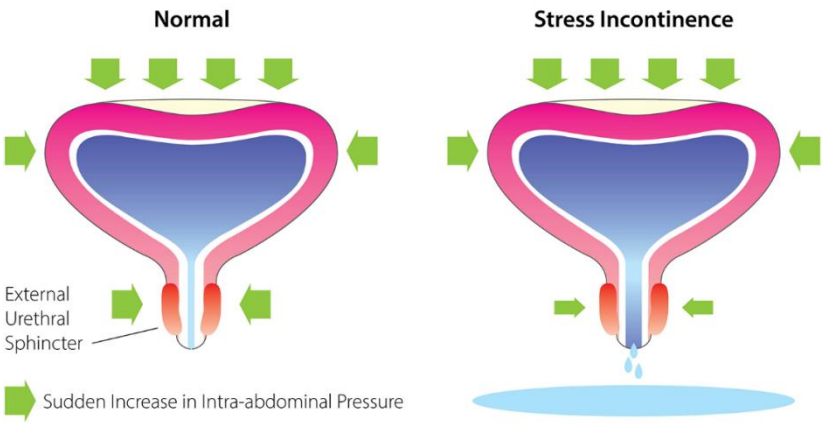

Figure 18: Mechanism of SUI (Stress Urinary Incontinence (SUI), 2019)

2.1.2 Urgency Urinary Incontinence / Overactive Bladder

Urgency urinary incontinence (UUI) remains predominantly idiopathic. It manifests as a "disorder of bladder control during the storage phase, characterized by (...) abnormal and compelling desire to void that is difficult to defer" (Morris, 2013, p. 441) with or without urgency or mixed urinary incontinence (Rahnama'i, 2018).

The current hypothesis assumes that cause is multifactorial and consists of neurological origin and myogenic changes represented by involuntary detrusor overactivity or bladder hypersensitivity (Aoki et al., 2017). The study of Morris (2013) has shown a difference in regional brain activity in women with and without incontinence, however further research is needed to clarify the effect of these different mechanisms on fluid control.

UUI is a symptom of overactive bladder syndrome (OAB). OAB is characterized by "urinary urgency, usually accompanied by frequency and nocturia, with or without urgency urinary incontinence, in the absence of urinary tract infection or other obvious pathology" (Haylen et al., 2010, p. 7). The mechanism is shown in figure 19.

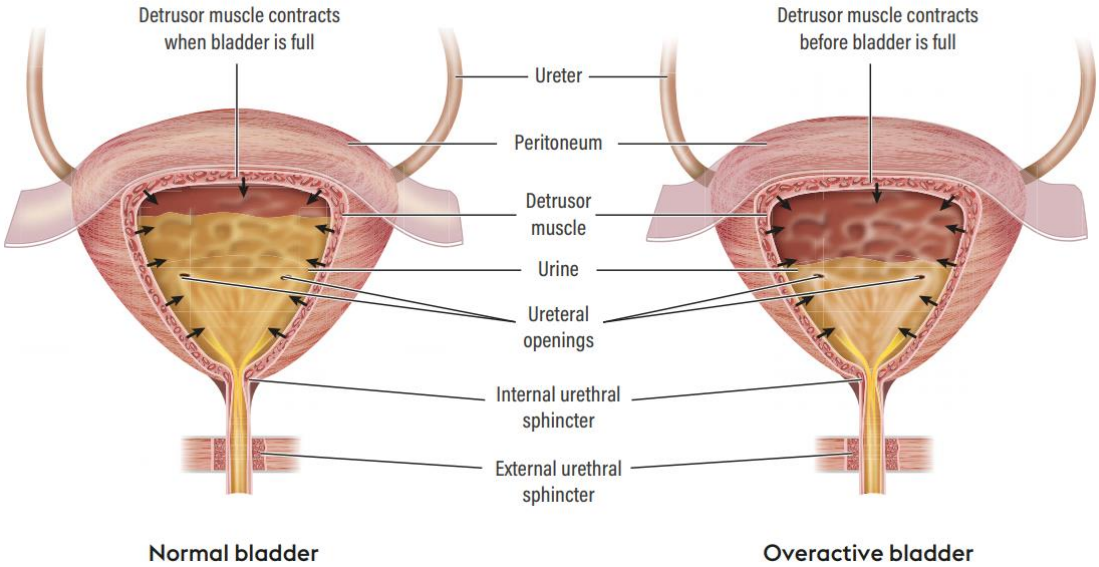

Figure 19: Normal and overactive bladder function (Jenks, 2016)

Holstege (2005) suggests OAB to be a brain disease with lesions in the areas of micturition controls, described above in chapter 1.4.

According to Otčenášek (2017), urinary urgency felt more than eight times a day is considered frequent and micturition more than ten times a day is regarded pathological if not explained by increased fluid intake.

2.1.3 Mixed Urinary Incontinence

Mixed urinary incontinence (MUI) is a combination of symptoms with both urgency (UUI) and physical activity, effort, sneezing and coughing (SUI).

The symptoms are often inconsistent and they may as well occur as a patterned behavior in patients with SUI, called Pseudo-urgency syndrome. Patients “retrain the bladder by urinating more frequently to avoid leakage associated with SUI. The patient may rush to the restroom to urinate at the first sensation or first desire” (Bandukwala & Gousse, 2015, p. 9).

The study of Sensoy et al. (2013) has proved a more significant decrease in quality of life with MUI than either isolated SUI or UUI.

2.2 Prevalence

As UI is a delicate issue with the social stigma attached, there is a tendency to underreport the condition. Also, the methodologies, studied subjects and inconsistent UI definitions (especially in the frequency of leakage) make the studies complicated to compare and the estimated prevalence may considerably vary (Bardsley, 2016; Schreiber Pedersen et al., 2017).

According to the study of Peyrat et al. (2002), the mean prevalence among young and middle-age woman is 27.5%, "increasing to 38.5% in those aged 40 - 62 years, but decreasing to only 18.2% in women aged 25–39 years and 6.2% in those aged < 25 years" (Peyrat et al., 2002, p. 63). The results include both occasional and frequent (2 incidents/day or more) leakage.

In the trial of Schreiber Pedersen et al. (2017), German women age 18 – 96 years were examined. Overall, 48.3 % of them experienced involuntary urinary loss at least sometimes during the past four weeks within the examination period. Detailed results, including division into the age groups and types of experienced UI is shown in table 1.

Table 1: Prevalence of UI types according to age among German women (Schreiber Pedersen et al., 2017)

Age groups (years)	n_{total}	UI %	SUI %	UUI %	MUI %
18 – 29	34	18.8	7.7	6.1	5
30 – 39	78	37.1	23.3	5.7	8.1
40 – 49	227	49.9	27.9	8.6	13.4
50 – 59	298	57.8	29.8	11.4	16.5
60 – 69	143	50	23.1	14	12.9
70 – 79	83	55.3	23.3	14	18
80 +	31	60.8	13.7	33.3	13.7
All ages	**894**	**48.3**	**24.5**	**10.7**	**13.1**

n_{total}: total number of women experiencing UI

UI: urinary incontinence

SUI: stress urinary incontinence

UUI: urge urinary incontinence

MUI: mixed urinary incontinence

2.3 Risk Factors

UI is affected by many internal and external factors. The most significant risk factors are female sex and age, followed by obesity and vaginal delivery (Schreiber Pedersen et al., 2017).

2.3.1 Internal Factors

Internal factors include gender, age and family history.

Sex & Age

"Although women report incontinence more often than men, after 80 years of age, both sexes are affected equal" (Khandelwal et al., 2013, p. 543). Overall, the ratio of UI prevalence in women and men is 2:1. One of the reasons may be the shorter length of the female urethra and thus greater susceptibility to incontinence. Reduced mobility and therefore difficulties in reaching the bathroom can also contribute to increasing prevalence with advanced age (Landefeld, 2008; Markland et al., 2010).

In men, UI has a greater impact on decreasing the quality of life and impairment of emotional health than in women, even though they are in better physical shape and the leakage is less severe. They usually also feel frustrated and more limited in social life. One explanation for this may be women consider involuntary urine loss as one of the consequences of pregnancy and childbirth and are used to handle menstruation bleeding (Lagro-Janssen et al., 2008).

2.3.2 External Factors

The most significant external factors affecting urinary incontinence are obesity, pregnancy and parturition, hysterectomy, sports practice and sedentarism.

Obesity

According to Marcelissen et al. (2019), both urgency and stress urinary incontinence is significantly affected by obesity and weight loss improves symptoms of UI. Mechanical factors, as well as metabolic ones, are involved in systematic inflammation and increased oxidative stress as a result of released cytokines in visceral adipose tissue and they correlate with lower urinary tract symptoms, including UI.

As body weight affects an intraabdominal pressure, among young (< 50 years of age) obese patients stress urinary incontinence is considerably more prevalent (27 %) compared to urgency urinary incontinence (11 %) (Brucker et al., 2017). The study of Waetjen et al. (2006) demonstrated that a body mass index (BMI) rise of 5 kg/m^2 increases SUI by 30 % and UUI by 15 %.

A positive weight loss effect on UI has also been explored in the study by Burgio et al. (2007). 92 women with morbid obesity (BMI > 40 kg/m^2) age 20 – 55 years underwent bariatric surgery. Questionnaires evaluating the severity and effect of UI were used before the surgery and during the 6 and 12 months follow-ups. “Mean BMI decreased from 48.9±7.2 presurgery to 35.3±6.5 at 6 months and 30.2±5.7 at 12 months postsurgery. Prevalence of UI decreased from 66.7 % presurgery to 41.0 % at 6 months and 37.0 % at 12 months” (Burgio et al., 2007, p. 1034), as shown in figure 21.

Variable	N*	Before Surgery	6 Months Postsurgery	12 Months Postsurgery
Any urinary incontinence	92	66.7	41.0	37.0
Any stress incontinence	92	59.8	37.4	31.5
Any urge incontinence	92	35.9	15.7	15.2
Mixed incontinence	92	31.6	12.1	9.9

Figure 21: Change in Urinary Symptoms at 6 and 12 Months After Bariatric Surgery

N*: total number of participants

Pregnancy, Vaginal and Abdominal Delivery (C-section)

Prevalence of urinary incontinence increase during pregnancy from 15 % in the first trimester up to 80 % in the third trimester. Among primiparas, the prevalence is 15 – 50 % compared to 35 -70 % among multiparas. (Deffieux 2009; Vašek et al., 2019).

Urinary incontinence occurs 1,5x more often among women experienced C-section and 2,3x more frequently among the ones after the vaginal delivery in comparison to women without any delivery. Prevalence of the UI in women after vaginal delivery is 67 % higher than in women after C-section 20 years after the delivery (Kokabi & Yazdanpanah, 2017; Vašek et al., 2019).

The age of a woman at first birth also plays an important role. Primipara older than 30 years of age doubles the risk of pelvic organ prolapse and the need for surgery due to SUI in the future contrary to primipara younger than 30 years of age. With every additional year, the risk of a woman suffering from urinary incontinence in the future increases by 3 % (Vašek et al., 2019).

Development of UI in pregnancy is caused by increased pressure on the urinary bladder and pelvic floor muscles, relaxing effect of progesterone and relaxin and reduction of the strength of collagen in tissues (Horng, 2017; Martínez et al., 2014; Vašek et al., 2019).

During a vaginal delivery, the pudendal nerve is compressed and partial denervation occurs in m. levator ani and m. sphincter ani externus, which has been found by electromyographic examination in 42–80 % women after vaginal birth. Furthermore, the deformation of soft tissues around the birth canal occurs. The baby weight proved to be statistically significant at a weight of over 4000 g (Vašek et al., 2019).

The most significant sign for SUI is the incidence of UI during the first pregnancy. Mothers with persistent SUI three months after delivery have a 92 % risk of experiencing SUI in a five-year follow-up by way of contrast to 19 % risk in women who did not suffer from SUI during the first pregnancy (Vašek et al., 2019).

Hysterectomy

The study of Bohlin et al. (2017) examined the relation between hysterectomy and urinary incontinence in 16 182 women. It showed that 8.5 % began to suffer from UI after hysterectomy, remission of UI occurred in 13.3 % and residual UI appeared in 16.1 %. Vaginal hysterectomy had lower remission on the contrary to abdominal hysterectomy.

Sedentarism

The sedentary lifestyle is defined as a dominant static seated position during professional activity or leisure (Steenstrup et al., 2018).

In 2015a, Da Roza et al. compared the levels of physical and sport activity (PSA) in a population of 81 young women (age 24.9 ± 4.5) using an accelerometer. The authors found a prevalence of UI of 14.5 % in the sedentary group and 11.6 % in the moderate physical activity group(149.5 ± 33.5 min/week).

Sapsford et al. (2008) find a link between the quality of the sitting position, the activation of the pelvic floor muscles and the m. transversus abdominis, and the UI. In their study 17 women after vaginal delivery were examined, 8 with symptoms of SUI and 9 without. Electromyographic examination of the pelvic floor and abdominal muscles took part in 2 sitting positions, upright unsupported (A) and slump supported (B), as shown in figure 22.

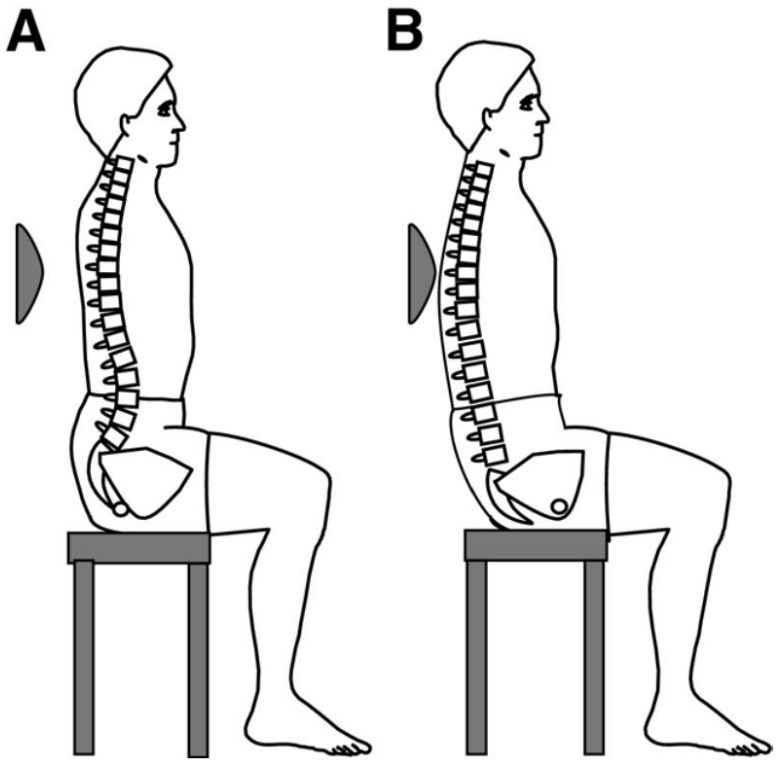

Figure 22: Sitting postures used in the study (Sapsford et al., 2008)

A: upright unsupported

B: slump supported

“The results of this study indicate that activity of the PFM (pelvic floor muscles – A/N) is affected by sitting posture in women with and without SUI. Although the group of symptomatic women, most of whom had severe SUI, had less PFM electromyographic activity and a tendency toward greater activity of the superficial abdominal muscles than the continent women, activity of the pelvic floor and obliquus internus and transversus abdominis muscles increased in both groups when moving from a slumped to an upright unsupported sitting posture. The lower activity of the PFM was associated with reduced lumbar lordosis. These data support the hypothesis that lumbopelvic posture affects the activation of the PFM” (Sapsford et al., 2008, p. 1744-1745).

However, there are limited data available researching a sedentary lifestyle and its relation to developing UI. Also pathophysiological mechanism persists insufficiently clarified. Nonetheless, Steenstrup et al. (2018) stated in their literature review 5 UI risk factors that could be linked to a sedentary lifestyle, such as age, metabolic factors, dysfunctions of the muscle structures responsible for continence, postural factor and social and environmental factors.

Sports Practice

As well as a sedentary lifestyle, repeated excessive high-impact physical activity is associated with a higher prevalence of incontinence. A frequent sudden increase in intraabdominal pressure may impact the supporting structures of the pelvic floor and jeopardizes its proper functioning. Also, when urethral closure pressure is exceeded, stress urinary incontinence arises (Da Roza et al., 2015a). Haylen et al. (2009) suggest the use of the term "activity-related incontinence" as a precaution of confusion with psychological stress.

Study of Thyssen et al. (2002) examined female elite athletes in eight various sports (gymnastics, badminton, basketball, volleyball, track athletics, handball, aerobics and ballet) and in the age range 14 to 51 years. 8.6 % of the women had given birth. 51.9 % of the athletes experienced urine leakage. Figure 23 provides a more detailed overview of examined sports and incontinence prevalence.

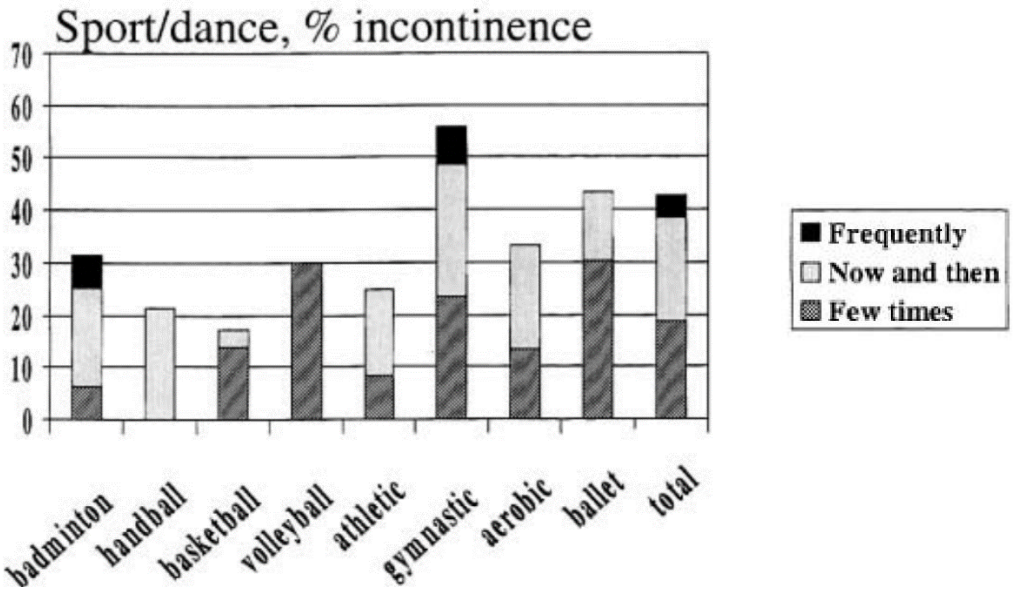

Figure 23: Percentage of elite female athletes who experienced urinary leakage (Thyssen et al., 2002)

The activity provoking leakage the most seems to be high-impact jumping often occurring, for example, in gymnastics. Study of Da Roza et al. (2015b) revealed that 72.7 % Portuguese trampolinists in the age range 14 – 25 years experienced urine leakage. Gram & Bø (2019) examined rhythmic gymnasts with a mean age of 14.5 (± 1.6) years and 31.8 % suffered from urinary leakage. A meta-analysis by De Mattos

Lourenco et al. (2018) demonstrates the relationship between the impact of physical activity and the prevalence of UI, as shown in table 2.

Table 2: Prevalence of UI according to impact of PA (De Mattos Lourenco et al., 2018)

	Total	UI athletes	%
High impact	Total	UI athletes	Prevalence
Basketball	45	19	42.22%
Football	38	19	50.00%
Gymnastics	371	227	61.19%
Tennis	6	3	50.00%
Volleyball	139	80	57.55%
Total	599	348	58.10%
Medium impact	Total	UI athletes	Prevalence
Hockey	19	6	31.58%
Judo	9	4	44.44%
Running	635	197	31.02%
Softball	16	1	6.25%
Track and field	63	1	6.25%
Total	742	226	30.46%
Low impact	Total	UI athletes	Prevalence
Bodybuilding	164	23	14.02%
Cycling	89	8	10.11%
Hiking	99	12	12.12%
Pilates	36	2	5.56%
Swimming	118	18	15.25%
Total	506	64	12.64%

Even though the symptoms of UI in the population of young, non-obese nulliparous women have no clear anatomical causes yet, “the most reliable theory is that strenuous exercises may prompt the early onset of incontinence symptoms that would appear later in life in predisposed women” (De Mattos Lourenco et al., 2018, p. 1762). The prevention in the form of pelvic floor muscle training is suggested to start simultaneously as they start exercising (De Mattos Lourenco et al., 2018).

3 DIAGNOSTIC METHODS

A complex examination is necessary to define the aggravating causes, impact on quality of life and patient's desire for treatment. "The typical diagnostic work-up involves medical history, physical examination, urinalysis, assessment of post-void residual volume and exclusion of conditions that require specialist referral" (Aoki et al., 2017, p.5). Standardized incontinence questionnaires are also widely used to evaluate the type of UI and its impact on the quality of life. The diagnostic process sequence is shown in figure 24.

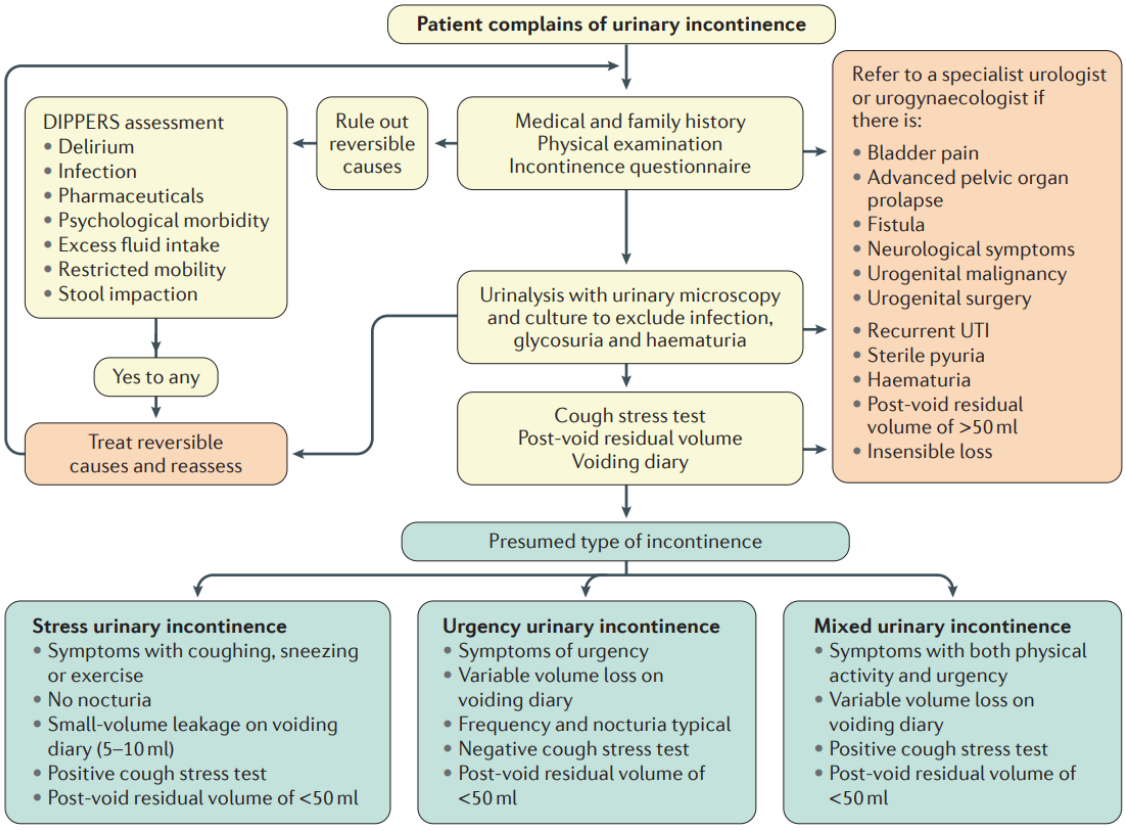

Figure 24: Diagnostic of women with urinary incontinence (Aoki et al, 2017)

3.1 Patient History

When obtaining a patient history, the interview also serves to establish essential trust between the patient and the therapist (Havlíčková, 2017). The Mojzis method (Method of Ludmila Mojžíšová) states several subjective difficulties typical for the hypertonic pelvic floor, such as headache, dysmenorrhea (menstrual pain), dyspareunia (difficult or painful sexual intercourse), painful defecation and repeated spontaneous abortions in the first weeks of pregnancy without pathology of embryogenesis. From a psychosomatic point of view, we observe strain, fear, neurosis, anxiety and stress (Jedličková, 2019).

3.1.1 Standardized Incontinence Questionnaires

Incontinence questionnaires help to detect the type and extent of UI. Validated symptom questionnaires are no longer recommended due to their insufficient informative value and ones evaluating the quality of life should be used instead. Appropriate questionnaires assess the influence of the specific symptoms on the quality of life and comprehensively describe their impact on both the physical and mental health of patients, as well as theirs social activities. They are considered as a significant parameter classifying success of treatment when no other disease activity proofs are available (Zachoval et al.,2006). Contlife, ICQ-UI SF, OAB-q and many others have a Grade A level of validation standing for valid and reliable data and highly recommended for use by the review of Donoval et al. (n.d.).

Contlife

Contlife is a questionnaire designed for women experiencing stress urinary incontinence. It includes 28 questions checking the status in the past four weeks. The parameters of daily activities, effort, self-image, emotional consequences, sexuality and overall quality of life are evaluated on a scale from 0 to 100, where 0 represents high and 100 low quality of life available (Zachoval et al.,2006). Contlife is enclosed as attachment 1.

International Consultation on Incontinence Questionnaire - Urinary Incontinence Short Form (ICIQ-UI SF)

ICIQ-UI SF is a short, simple questionnaire applicable to both sexes. It evaluates frequency, volume, leakage and overall impact of UI over the past four weeks. The scale is 0 to 21. The higher the number, the higher the negative impact. ICIQ-UI SF is enclosed as attachment 2 (Lim et al., 2019).

Overactive Bladder Questionnaire (OAB-q)

OAB-q is a 4-week recall questionnaire containing 33 items. The First eight questions ask about symptom bother when higher evaluation represents greater bother. Remaining questions covers quality parameters when the greater score, the higher health-related quality of life, such as coping, concern, sleep, and social interaction. The shorter one-week version is also available. 4-week OAB-q is enclosed as attachment 3 (Barsdorf et al., 2017).

3.2 Urological Tests

Other diagnostic methods are specific urological tests, such as ultrasonography imaging, cough stress test, voiding diary and pad tests, performed by doctors or specialized physiotherapists (Aoki et al., 2017; Henderson et al., 2018).

3.2.1 Ultrasound Imaging

Ultrasound has "been used to investigate urinary incontinence by visualizing the morphology, movement and function of structures, including the levator ani, pelvic organs, bladder, bladder neck, urethral sphincter and urethra. Although abnormalities observed can be associated with urinary incontinence, such imaging is not predictive or diagnostic of the cause of the incontinence" (Aoki et al., 2017, p. 10).

3.2.2 Cough Stress Test

The cough stress test is used to diagnose stress urinary incontinence at which an intraabdominal pressure increase is induced by cough or Valsalva maneuver to inspect urinary leakage. The test is the most sensitive (83 %) and specific (90 %) when performed with a bladder filled to half of its functional capacity (Henderson et al., 2018).

3.2.3 Voiding Diary

Voiding diaries are used as an objective measurement tool of voided volume, frequency and urinary incontinence frequency. Three types of diaries are being used to record the time of voiding, frequency and volume and additional information on leakage episodes, such as pad usage, fluid intake and feelings of urgency. The diary also helps to detect nocturia (Aoki et al., 2017).

3.2.4 Pad Test

The test uses an absorbent pad worn to identify the volume of urinary leakage. A positive test is characterized as a weight increase of more than 1 gram in 1 hour or more than 4 grams in 24 hours. Part of the increase may be caused by perspiration (Aoki et al., 2017).

3.3 Physical Examination

Physical examination may be performed both by evaluation of the musculoskeletal system externally and by digital palpation of pelvic floor muscles per rectum or per

vaginam. A manometer is being used to assess the squeeze pressure. Digital examination per vaginam is used to state the PERFECT schema (Aguilar et al., 2017).

According to The Mojzis method, several typical physical examination findings indicate pelvic floor hypertone. The findings are subsequently confirmed by examination per rectum.

Pelvic floor hypertone is characterized by pain of soft tissues in the area of os coccyx, reduced static load tolerance when standing, pain in hypogastrium and in the area of hip adductors (Jedličková, 2019).

Unilateral pelvic muscle spasm causes pelvic girdle torsion (unilateral anterior pelvic tilt), contralateral sacroiliac joint blockade, asymmetric subgluteal lines and gluteal muscles activation, painful pressure on ligamentum sacrotuberale, ramus superior ossis pubis, symphysis and coccyx (anterior and lateral sides), trigger points in m. gluteus maximus and external hip rotators (Jedličková, 2019).

Bilateral spasm is usually asymmetrical, which manifests as unilateral spasm. Rarely, symmetric bilateral spasm occurs and is characterized by stiffer sacroiliac joint and no pelvic torsion. Spasms can be confirmed with certainty only after examination per rectum (Jedličková, 2019) or per vaginam when muscle tone is palpated.

4 PHYSIOTHERAPY

A frequent finding in the pelvic floor muscles is a functional or structural disorder. The most common functional disorders include impaired awareness and dysfunction of isolated relaxation and activation of individual pelvic floor layers. Local pathologies and soft tissue imbalances should be corrected before specific pelvic floor therapy is initiated (Havlíčková, 2017).

Pelvic floor muscle training (PFMT) facilitates the correct voluntary contraction and relaxation of pelvic floor muscles. Work of Tibaek & Dehlendorff (2014) shows that 70 % of women suffering from pelvic floor dysfunction cannot correctly voluntarily contract the pelvic floor muscles.

Therefore, several methods are being used to induce optimal contraction, including palpation, biofeedback and verbal instructions (Mateus-Vasconcelos et al., 2017). The cure-rate of PFMT in stress urinary incontinence is about 50 % (Nilsen et al., 2018).

Pelvic floor muscles exercise is often executed in a supine position. However, this position does not correspond to the average load in the gravitational field, so it is advisable to start in a supine position and gradually move to more challenging vertical positions in therapy (Havlíčková, 2017).

There are many approaches to specific pelvic floor therapy, in the following subchapters will be described The Mojzis Method, Ostrava Concept, Kegel Exercise, Dynamic Neuromuscular Stabilization and Psychosomatic Approach. Some other approaches use vaginal cones or balls, however, according to the only available meta-analysis so far, performed by Oblasser et al. (2015), their use does not significantly change treatment success. A systematic review of Nunes et al. (2019) stated that also biofeedback has no additional positive therapeutic effect on female stress urinary incontinence compared to pelvic floor muscle training and vaginal electrostimulation. Yoga, although not a classical physiotherapeutic concept, has also been used in several works (Huang et al., 2018; Vinchurkar & Arankalle, 2014) to treat urinary incontinence and will therefore be described in the next subchapter.

4.1 The Mojzis Method

The method of Ludmila Mojžíšová (The Mojzis Method) comprises mobilization of the ribs, sternoclavicular acromioclavicular and sacroiliac joints, spine and coccyx. Functional disorders in the area of the ribs and clavicle lead to a change in the position of the pelvis, resulting in muscle disbalances and blockages (Velinská, 2007).

The intention of the pelvic therapy is to releases sacroiliac joint, gluteal muscles, m. coccygeus and m. levator ani, reducing the coccyx pulling and optimizing its position. The method also includes ten basic exercises that are used for women suffering from functional sterility (Velinská, 2007).

4.2 Ostrava Concept

Ostrava Concept is a standardized comprehensive approach. It uses standardized diagnostic and therapeutic protocols. The uniqueness of the concept lies in the interconnection of postural activity with isolated contraction of individual functional layers of pelvic floor muscles (Holaňová & Krhut, 2010)

Patients whose pelvic floor muscle contraction is not of sufficient quality use electrostimulation probe to facilitate and improve the perception of the pelvic region in a combined biofeedback program. In patients experiencing overactive bladder, therapy is also focused on micturition training and behavioral therapy (Holaňová & Krhut, 2010)

4.3 Kegel Exercises

Kegel's therapy is not an official physiotherapeutic concept and it is not build on evidence-based medicine knowledge. However, it is still widely used worldwide.

Kegel was the first to report the effect of regular, specific strength training of the pelvic floor muscles on female urinary incontinence. His exercise program consists of two parts, muscle awareness and resistive exercise (Bø & Herbert, 2013; Kegel, 1951)

4.4 Dynamic Neuromuscular Stabilization

“Dynamic Neuromuscular Stabilization, or “DNS” as it is commonly referred to, is a manual and rehabilitative approach to optimize the movement system based upon the scientific principles of developmental kinesiology” (Frank et al., 2013, p. 62).

The concept greatly works with the intra-abdominal pressure and integrated spinal stabilizing system (ISSS) and its role in creating functional spinal stability. As pelvic floor muscles integrate with the ontogenesis into the ISSS, utilization of DNS is broad. An adult should be able to control pelvic floor muscles in all postural options completely. Optimal intra-abdominal pressure created by the cooperation of all components of ISSS is shown in figure 25 (Frank et al., 2013; Prokešová 2017).

Due to mutual functional interconnection, the system as a whole reacts to single muscle dysfunction and this disorder has to be solved again globally, not only with isolated contraction of the pelvic floor (Prokešová 2017).

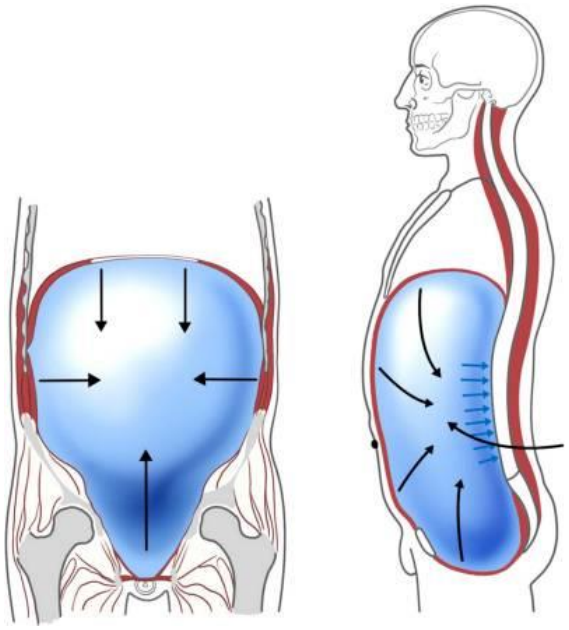

Figure 25: Intra-abdominal pressure regulation by diaphragma, pelvic floor and m. transversus abdominis (Frank et al., 2013)

4.5 Psychosomatic Approach

Like everything in the human body, continence is influenced by our mental state and vice versa. However, the bond between urinary incontinence and mental state outcomes is not evident, anxiety is assumed to prompt leakage episodes. Likewise, incontinence may contribute to anxiety feelings. Furthermore, depression may develop from lack of social functioning as the patients are afraid to travel far from home (Coyne, 2002).

According to the study of Melville et al. (2002), 24 % of women suffering from UUI reported depression in contrast to 3 % with SUI. The overall relationship between

urinary incontinence and depression examined Dugan et al. (2000) and detected 43 % incontinent adults (mix sex) with depressive symptoms in contrast to 30 % of depressive continent ones.

In the Czech area, the psychosomatic attitude is widely used in the therapy approaches of Bc. Clara Lewitová called Physiotherapy of Function.

4.6 Yoga

Yoga is a system of philosophy, lifestyle and physical practice which originated in ancient India. It includes several body postures (asana), breathing exercises (pranayama), and meditation (dhyana). Due to its wide range, it affects both mental and physical aspects of man (Sha et al., 2019; Wieland, 2017).

The worldwide popularity of yoga is growing. In 2002, 5.1 % of adult Americans reported the use of yoga in contrast to 2012 when it was 9.5 %. Therefore, it can be a natural, safe and well-accepted form of prevention and therapy of urinary incontinence with high adherence (Huang et al., 2014; Wieland et al., 2017).

In the review of Sha et al. (2019), all studies suggested the decrease of lower urinary tract symptoms after yoga intervention is caused by strengthening the pelvic floor muscles, regulating the autonomous nervous system and activating the central nervous system. However, direct evidence of these connections was not proved.

"By promoting awareness and control over individual muscle groups through the practice of specific yoga postures, yoga can be used to help women identify and strengthen their pelvic floor muscles (...).With its focus on deep breathing and mindful meditation, yoga can also be useful in reducing anxiety, perceived stress, and associated autonomic nervous system imbalance" (Huang et al., 2014, p. 147).

Inverted asanas, such as Sarvangasana (candle pose, shoulder stand), are also widely used for their regenerative effect on the pathologically activated pelvic floor, as described in chapter 1.6 (Pospíšil, 2019).

5 CASE REPORT

Prior to the examination and therapy, the patient signed an informed agreement, which can be found in the attachment 4. The therapeutic procedure included an initial examination, seven therapies and a final assessment.

5.1 Patient History

Patient Identification Information

Patient: E.H., female, 18 y.o., right hand dominant, right foot dominant

Chief Complaints:

Involuntary leakage of urine, severe after surgical dilation of the urethra for pathological narrowing (last time 08/2018) and still current in a mild form. The last significant leakage episode was recorded last weekend after an elbow strike in a hypogastrium in a basketball match. The patient feels no limitations in activities of daily life nor sport.

Patient Personal History:

The patient suffered from a pathological narrowing of the urethra, which was surgically dilated three times (2006, 2011, 2018). The bladder inflammation was the cause in the first and third events, for the second one the cause is unclear. She is being monitored for nephrology.

Ankle fracture (2017), healed without complications and without persistent changes in a range of motion nor strength.

Family History:

The patient's sister experienced kidney inflammation in childhood. Aunts on her father's side occasionally suffer from the bladder inflammation.

Occupation and Social History:

High school student.

Sport History:

The patient plays basketball since six years of age. The practice takes part 8 times a week for 1.5 (including warm-up and cool down) + match three times a week. Once a week, the team has a 30 minutes group compensatory exercise session with its physiotherapist. Moreover, a sauna or cryo-chamber is used once a week to regenerate.

Rehabilitation History:

Physiotherapy after the ankle fracture (2017).

Allergy History:

The patient has no allergies.

Pharmacologic History:

The patient does not take any medication.

Gynecological History:

Menarche was at the age of fifteen. The cycle is regular and menstruation is painful during the first three days. The volume of blood in the first three days is rather high. After consulting a gynecologist, she was advised to take the Ibuprofen in case of severe pain. She feels discomfort, fatigue, and leg stiffness while training during the period. The patient uses tampons and therefore, she is not sure whether the blood contains coagulates or not. No sexual life yet, does not use birth control.

Physiological Functions:

In the past, the patient experienced troubles with falling asleep, but for the last six months, it was alright. The troubles come in waves, she assumes the cause is the basketball practice timing as the difficulties occurred after late practices. She regularly sleeps eight to nine hours per night, sometimes she feels tired in the morning. She does not feel stressed, however she feels constant fatigue. No caffeine consumption.

Patient's Expectations of Rehabilitation Sessions:

Improve continence, mainly ensuing urine leakage after voluntary urination, prevent further bladder inflammation and pathological narrowing of the urethra.

5.2 Initial Assessment

Kinesiological analysis form from the Czech Society of Sports Medicine, enclosed as an attachment 5, and examination by The Mojzis method were mostly used for musculoskeletal assessment of the patient. The didactic division of assessments is based on those methods. Contlife, OAB-q and ICIQ – UI SF standardized incontinence questionnaires were used to evaluate patient's incontinence status and quality of life in the past four weeks.

5.2.1 Static Stand Assessment

The patient was examined in a normal stance from the front, back and side view. It was performed in all cases first by observation, secondly by palpation and finally by an anthropometric examination.

Front View

Due to the sensitive topic and young age of the patient, the examination was initiated from the front side to establish greater trust between her and the therapist.

In the first impression, there is the discrepancy between the upper and lower half of the body, when the lower limbs are hypotonic and the torso with the upper limbs are hypertonic.

The longitudinal foot arches were in the norm, the left arch was higher, whereas the transversal arches were bilaterally lowered. Left hallux was slightly yawed inward and overall toe activity was increased. Windlass mechanism decreased bilaterally.

Right calf narrower than the left calf and left m. quadriceps femoris was more pronounced than the right one, even though the circumference was identical on both tights.

The area around trochanter major femoris was bilaterally without significant convexities. During the anthropometric examination, the circumference in the area of trochanters was 96 cm and the waistline was 68 cm, therefore the waist-hip ratio is 0,71. Right spina ischiadica anterior superior was higher than the left one.

M. rectus abdominis was hypertonic, the umbilicus was pulled up and left and slight concavities were visible on the abdomen, the waist was narrow. Breathing occurred mostly ventrally in the lower abdomen.

Both arms are drawn to the body, the right thoracobrachial triangle was more pronounced. Thorax was notably narrowed. The left shoulder was higher than the right one and the head was in mild lateroflexion to the right.

Back View

Ankles in physiological position. Left popliteal line descended from medial to the lateral side, left subgluteal line was lower than the right one. Skin in the area of kidneys was wavy and had a blue-gray color, which may indicate an algic zone. Mild decompensated structural scoliosis, the plumb line did no pass the intergluteal line but was shifted to the right. Margo medialis scapulae protrude bilaterally, the right one more than the left one. Ears are symmetric.

Side View

Weight was significantly on the forefoot. The line hip–knee-ankle was pathological, manifesting position of hips ventrally in front of the knees and ankle dorsally behind the knees.

Thorax was notably ventro-dorsally narrowed, the thoracic spine was flattened and sternum protruded forward. Collarbones were significantly prominent, shoulders were in protraction and head was forward.

5.2.2 Dynamic Tests in Standing

All Rhomberg's tests, Duchenne sign and Trendelenburg sign were negative. Leaning (Véle's) test was positive.

During the squat, the fingers were elevated from the ground and the center of gravity was shifted backward and inward, toes were unstable, the head was in a forward posture.

The ability to relax was physiological, except toe relaxation.

5.2.3 Spinal Mobility Assessment

Thomayer's test negative, the patient reaches the fingers of both hands to the floor in a relaxed forward bend. Schober's test, evaluating restrictions in lumbar flexion, was in the norm, the distance L5 + 10 cm increased by 5 cm when bending forward. Stibor's test was in the norm as well, the distance L5 – C7 increased by 11 cm when bending

forward, thus both thoracic and lumbar spine had a physiological range of motion. However, when testing the thoracic spine separately, a reduced range of motion by an Otto's inclining test was found (+ 1 cm). Forestier fleche (Flèche occipital) was positive (2 cm) due to the forward head posture. Lateroflexion was bilaterally symmetric.

5.2.4 Sitting Assessment

Hip flexion test negative, as well as diadochokinesis, indicating sufficient postural control. Somatognosia in the norm, tested by shoulder-width test (difference +2 cm). Pain during palpation examination of ribs and collarbone negated, in spite of significant dermographism.

Chest expansion normal in all four lines, 5 cm at the axillae and 7 cm at the mesosternale level, 4 cm in the area of processus xiphoideus and 6 cm in the mid-length of processus xiphoideus and umbilicus.

5.2.5 Supine Position Assessment

Anthropometry of lower limb length was bilaterally symmetric for all anatomic (trochanter major – malleolus lateralis), relative (spina iliaca anterior superior – malleolus medialis) and umbilicus – malleolus medialis distances. Hyporeflexia of abdominal reflexes on the right. Hyporeflexia of lower limb reflexes on the left. Somatognosia and stereognosia were in the norm. Isolated feet movement in the norm. The range of motion in hips increased for both internal and external rotations, more on the left side.

Trigger points located bilaterally in the area of short adductors and m. rectus femoris. Trunk flexion test with slight hyperactivity of m. rectus abdominis, diastasis negative.

According to The Mojzis method, pelvic palpation examination was performed. Areas of symphysis and ramus superior ossis pubis were painless. No swelling was observed above the symphysis.

5.2.6 Prone Position Assessment

Palpation of sacrococcygeal joint, ligamentum sacrotuberale and coccyx from the ventral side was painless. The palpation of coccyx area over a thin layer of underwear from the lateral and dorsal side was painful. No swelling was observed above os

sacrum. Asymmetric activation of gluteal muscles, right side activated more slowly compared to the left one.

5.2.7 Other tests

Among other used tests belong evaluation of the foot support on the podoscope, body perception and ability to evenly distribute the weight in the test on two scales and Beighton score to evaluate hypermobility.

Podoscope

Podoscope foot assessment was evaluated in both static stand and stand on one leg. Static stand podoscope is shown in figure 26, where there is a greater load on the right foot, no support for the little toes and bilaterally reduced support on the second and third toes, as well as the diminished load on the outer edge of the feet, more on the left side.

Figure 26: Podoscope foot assessment in static stand

While one-leg stand, shown in figure 27, the toes on the right feet were slightly more loaded, however, load on the second and fifth toe is still insufficient for providing optimal support, as well as the area of the lateral metacarpophalangeal joint.

The left little toe still showed no load as well as the area of the lateral metacarpophalangeal joint. The weight is bilaterally distributed more medially in both regular and one leg stands.

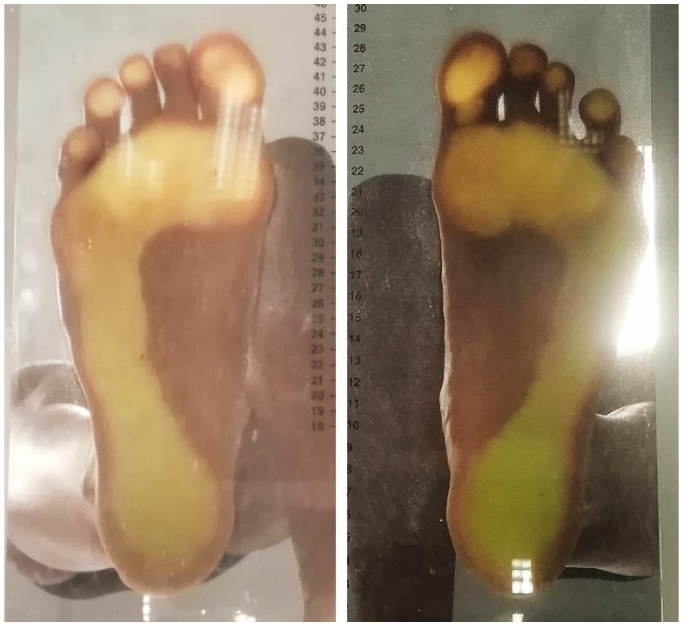

Figure 27: Podoscope foot assessment in one leg stand, both sides

Test on two scales

The test on two scales was negative. The weight was distributed slightly unevenly with a higher load on the left leg (34 kg) than on the right leg (31 kg), which is still within the limits of the standard up to 10%.

Beighton Score

Global hypermobility was negated using maneuvers of Beighton score, when the patient reached a score of 1 with a plus point for forward bend with fully extended knees and palms reaching the ground.

Standardized Incontinence Questionnaires

The Contlife questionnaire contains 28 aspects, divided into six dimensions — daily activities, effort activities, self-image, emotional consequences, sexuality, well-being and global score. The patient received the most optimal result possible in all parts, the lowest evaluation of negative manifestations and the highest rating of life quality.

The OAB-q questionnaire turned out similarly optimal, the only slightly negative display was nocturia rated with 2 points, meaning the patient experienced it a little of the time for the past four weeks.

The IC IQ – UI SF questionnaire evaluates frequency, severity and impact on life quality. It indicated that the patient is now without any urinary problems. However, in a comment, she stated that although she is without any trouble at the moment, her urine leaked several times a day and interfered with her life 5/10 in the past.

5.3 Short-Term Rehabilitation plan

A short-term rehabilitation plan contains relaxation techniques inducing parasympathetic nervous system stimulation and the conscious release of pelvic floor muscles. It further includes breathing pattern optimization, treatment of hypertonic and palpably painful soft tissues, feet support correction and aware pelvic floor activation.

5.4 Long-Term Rehabilitation Plan

A long-term rehabilitation plan is focused on developing awareness of the patient's body, conscious relaxation and activation of the pelvic floor and its engagement into an integrated spine stabilizing system. All as a means to fulfill both patient's and therapist's goals of relieving urine leakage after voluntary micturition, prevention of bladder inflammation and urethral narrowing.

5.5 Therapies

A total of seven therapies were conducted from November 2019 to March 2020, excluding sessions for initial and final examinations.

5.5.1 The First Therapy

The aim of the first therapy was to establish trust and a pleasant atmosphere between the patient and the therapist, respiratory physiotherapy and training of activation and relaxation of individual layers of the pelvic floor.

The therapy started with breathing techniques. First of them was localized contact breathing to induce optimal breathing pattern awareness and to stimulate the parasympathetic nervous system.

Afterward, we focused on conscious selective activation of individual pelvic floor layers. Exercises by Mgr. Martina Nakládalová were used (Nakládalová, 2019) when no visible pelvic movement occurs and activation only takes place inside the minor pelvis. Each of the three layers was activated separately to raise awareness and control of the area.

Subsequently, relaxation of pelvic floor induced using respiratory synkinesis and visualization. With inhale, the patient imagined a flower opening in her minor pelvis, with exhale she released while lying on her back with bend knees. This exercise comes from Nakládalová's course (Nakládalová, 2019). We focused only on the inhalation, relaxation part, as according to physical examination hypertone of the pelvic floor muscles is expected.

The following exercises were performed using the overball balance tool. The position of the patient was the same as in the previous exercise and overball was placed under her pelvis. Layers were separately activated and inhibited during three exercises. First of them was anteversion and retroversion of pelvis, second was to pull of one spina iliaca anterior superior upwards and third was approaching one tuber ischiadicum closer to the ipsilateral heel.

These three exercises were also prescribed to the patient as autotherapy of 15 repetitioons for two series once a day, preferably prior sleep to stimulate parasympathetic and thus improve the quality of sleep.

5.5.2 The Second Therapy

The aim of the second therapy was an optimization of the breathing stereotype throughout respiratory physiotherapy, relaxation and treatment of the muscles and joints connected to the pelvis.

After the first therapy, the patient experienced a less painful onset of the subsequent menstruation. Like last time, the second therapy started with breathing techniques. The first of them was wave breathing to which visualization of opening in the minor pelvis when inhaled was added. The aim of these exercises was to increase body awareness, relax pelvic floor muscles and to stimulate the parasympathetic nervous system.

Afterward, the sacroiliac joint was released using tigh thurst test, Stoddart tests and Toboggan exercise from the Mojzis method.

Subsequently, post isometric relaxation of m. iliopsoas, m. rectus femoris, m. tensor fasciae latae and hip adductors muscles was performed. Exercise using stretch effect of alternating eccentric and concentric contractions was used for releasing short hip adductors muscles, which was also one of two exercises for subsequent autotherapy.

The last exercise was a modification of sarvagasana (candle pose, shoulder stand) against the wall, inspired by Dinah Rodriguez and her hormone yoga therapy concept. Head and trunk were in a regular position, hips were slightly abducted and externally rotated, knees bent at right angles and feet gently pressing against the wall. When the patient found comfort in the position, breathing synkinesis with opening visualization was added. This also was the other exercise for autotherapy, the patient was instructed to practice both exercises once a day.

5.5.3 The Third Therapy

The aim of the third therapy was relaxation, treatment of the clavicles, ribs, pelvic ligaments and coccyx. The patient has not experienced any change since the last therapy.

The third therapy started with breathing exercise in a prone position with flower visualization to stimulate parasympathetic, relax the pelvic floor and increase self-awareness.

Thereafter, examination and treatment using The Mojzis Method was used for clavicles and ribs. The patient felt no pain during the palpation examination of rib springing. Sternoclavicular and acromioclavicular joints were treated as well as first five ribs on both the right and left side from both the ventral and dorsal sides. M. subclavius was not painful.

Subsequently, antigravity relaxation of m. rectus abdominis according to Lewit using post isometric relaxation was performed, followed by ligaments and coccyx treatment. Ligaments iliolumbale, sacroiliacale and sacrotuberale were treated by palpation compression. Coccyx was also treated by palpation compression from ventral, lateral and inferior sides, where the patient experienced mild pain in the area.

As the patient has troubles with the centering of the left scapula in the load, we used components of the pronation position exercise in the third month of the Dynamic Neuromuscular Stabilization concept. This exercise was along with sarvagasana (candle pose, shoulder stand) prescribed as a daily autotherapy.

5.5.4 The Fourth Therapy

The fourth therapy was focused on releasing hip rotator muscles and pelvic ligaments. It started with a breathing exercise with an opening visualization when inhale in supine

position with bend knees. During the breathing exercise, I manually centered the shoulders and stretched the soft tissues of the thorax.

Patient felt no changes since the last therapy. After the initial breathing, the ligaments and soft tissues around coccyx were treated the same was as in the previous therapy. Patient experienced a mild pain in the area of the caudal coccyx.

Afterwards, yoga poses Utthita trikonasana (triangle pose) on both sides and Prasarita padottanasana (wide-legged forward fold) were performed to release the hip rotator muscles, ligaments and sacroiliatic joint. The asanas (poses) are shown in figure 28 and 29.

Figure 28: Utthita trikonasana (Utthita Trikonasana: Triangle Pose, 2019)

Figure 29: Prasarita padottanasana (Prasarita padottanásana, 2019)

Scapula stabilization in the prone third month position of the DNS concept worked well, therefore we tried the fifth month position on the side from the same concept. Even at the mere lying on the left side, the left scapula markedly stood out and it was difficult to center it. When stabilized, we set the position in micro-motion with preparation for the turning to prone position.

For the autotherapy, the breathing exercises with an opening visualization, candle pose, uttita trikonasana and prasarita padottanasana were prescribed to do daily.

5.5.5 The Fifth Therapy

The fifth therapy was focused on correction of a feet support, engaging toes into it and integrated spine stabilizing system engagement in postural demanding positions. The goal was to increase the awareness and activity of the pelvic floor muscles during the daily activities.

The therapy started with breathing exercise and manual treatment of the pelvic ligaments and soft tissues around coccyx likewise in the previous therapies. It was the first time when patient felt no pain of the soft tissues around coccyx during digital palpation over the underwear. Also pelvic ligaments, mm. glutei and m. piriformis were more released than before.

Several changes occurred in the four weeks between the fourth and fifth therapy. The patient started a romantic relationship, started using a menstruation cup instead of tampons and experienced a mild relieve of menstruation pain. She felt overall happier. I suggested the use of sanitary pads instead of tampons/cup for less irritation from the external input in the inner pelvic area, but she prefers to use the cup.

For the increase of afferent stimulation from the feet and optimal support, the followed senzomotoric stimulation exercise was an Alphabet for our feet by Clara Lewitová (Lewitová, 2016).

Afterwards, isolated activation of the individual pelvic floor muscle layers were performed in supine position with bend knees. When mastered, pelvic floor muscle activation and hold in more postural challenging position followed, inspired by exercises of Nakládalová (Nakládalová, 2019). It went from side lying, prone position, supine third month position from DNS concept (one leg up, both legs up), seated position, eleven months position from DNS concept, standing to mild squat. We tried all

this positions to find the most challenging one where the patient is still able to activate integrated spine stabilizing system (including conscious activation of pelvic floor) without engagement of the superficial muscles like m. rectus abdominis and perineal muscles. The most optimal position was a mild squat with 30° knees flexion.

As an autotherapy were prescribed Alphabet for our feet and conscious activation and hold of pelvic floor muscles in mild squat.

5.5.6 The Sixth Therapy

The patient got a menstruation a couple of hours after the last therapy and she felt no pain. The menstruation came a week prior to the expected date.

After the initial breathing, the pelvis soft tissues were manually treated. Even though the mm. glutei and m. piriformis were without any trigger points, the soft tissues around coccyx were very sensitive and painful to the palpation pressure. They were released by ischemic compression. As the patient had no releasing autotherapy exercise from the therapy, I decided always to keep a pelvic floor releasing exercise in it from now on, as the area used to be much less painful.

We continued we the exercise from the last therapy, increasing afference to feet and consciously activating the pelvic floor muscles in posturally demanding positions. The mild squat worked well and this time also one-leg stand without the engagement of the superficial muscles was possible.

For the autotherapy were prescribed breathing with opening pelvis visualization to release the tension, Alphabet for our feet and conscious activation and hold of the pelvic floor in a one-leg stand with alternating legs.

5.5.7 The Seventh Therapy

Patient's menstruation is painless and she subjectively feels the urine leakage after micturition is smaller than before the therapy started. She feels overall good and confident.

The therapy started with an initial breathing and manual treatment of soft tissue area around coccyx, which was painless. From now on, I recommended keeping daily practicing both the releasing and activating exercises likewise the last autotherapy to keep improving the actual state.

As the left scapula was still problematic to stabilize, we spent the rest of the session with scapula centralization using elements of the Basal Postural Programs and Subprograms concept.

We ended our therapeutic sessions and the patient was instructed to continue with described autotherapy and contact me for therapy in the event of a worsening condition.

5.6 Final Assessment

The patient was cooperating and performed prescribed autotherapy. Objectively, the differences were observed in aspection, palpation and functional tests.

At first glance, the patient seemed relaxed. A greater symmetry of the left and right side of the body was seen, followed by slightly reduced m. rectus abdominis hypertone. From the back view still occurred mild scoliosis and bilaterally protruding margo medialis scapulae. The side view showed a physiological hip–knee-ankle line indicating improved feet support.

Leaning (Véle's) test was negative. During the squat, toes did not lift from the ground. During both the squat and the flexion tests was decreased m. rectus abdomins activation in favor of greater activation of deep abdominal and pelvic floor muscles.

In a prone position was observed symmetric gluteal activation. The palpation of the soft tissues around the coccyx area over underwear was painless. Unfortunately, podoscope foot assessment and test on two scales could not be performed due to coronavirus quarantine restrictions and prohibited entrance to the laboratories. Given the work on the feet support and the symmetrical perception of the body, positive changes in these tests were expected.

In the Contlife questionnaire was a deterioration by one point in the question number 13.: "Were you afraid of giving off an unpleasant odor?" where the answer was "rarely", ranked with 2 points. In the OAB-q questionnaire, question number 4 about nocturia was rated with 3 points as "some what". Questions number 12, 13 and 29, evaluating the feelings about individual bladder symptoms, were ranked with 2 points as "a little bit". In the ICIQ – UI SF questionnaire, the question "How often do you leak urine?" was answered by "about once a day", rated with 3 points, with "a small amount", rated with 2 points. Overall, the leakage interfere with her everyday life 1/10.

Subjectively, the patient evaluates our cooperation positively. She feels the urine leakage is slightly lower and it is improving slowly step by step. As a great success, she observes a reduction or almost disappearance of menstruation pain. Another positive is non-recurrent bladder inflammation. She acknowledges the pelvic floor therapy is a long process and she is willing to continue with autotherapy.

6 DISCUSSION

Urinary incontinence in female athletes is still an under-reported and therefore under-treated issue. Prevalence of reported urine leakage among female athletes diverse by sport. About 18 % of elite basketball players (Thyssen et al., 2002), 31.8 % 15-year-old gymnasts (Gram & Bø, 2019) and 72.7 % Portuguese trampolinists in the age range 14 – 25 years (Da Roza et al., 2015b) experienced it.

There are negative consequences, such as sport performance decrease and overall avoidance of physical activity. With the intervention of rehabilitation, symptoms can be significantly reduced and consequently the quality of life increases. (Casey & Temme, 2017).

In this study, the patient was an 18 years old female professional basketball player with mild urinary leakage. Therapies lasted five months, from November 2019 to March 2020, with autotherapy continued to date.

She performed exercises selected individually according to the current clinical findings. Elements of several concepts were used, such as The Mojzis method, Dynamic Neuromuscular Stabilization, Sensomotoric Stimulation, Yoga, Hormone Yoga Therapy by Dinah Rodriguez, soft tissue therapy and mobilization. The most used was set of exercises by Mgr. Martina Nakládalová (Nakládalová, 2019) using conscious selective activation and relaxation of individual layers of the pelvic floor and its cooperation with the rest of integrated spinal stabilizing system (ISSS).

The therapy always started with a breathing exercise with minor pelvis opening visualization. The aim was to increase the awareness and release tension in the area, induce optimal breathing pattern, to stimulate the parasympathetic nervous system and connect to herself.

The first and second therapy was focused on exploring the pelvic area and conscious relaxation and activation of individual layers of the pelvic floor. From the third therapy, manual treatment of the mm. glutei, m. piriformis, adjacent ligaments and soft tissues around coccyx area over underwear were added. The palpation of soft tissues around coccyx was painful up to fifth therapy. Afterward, the pain disappeared and returned only in the sixth therapy as a result of omitted releasing autotherapy between the fifth

and sixth sessions. Therefore, we decided to keep at least one release exercise in each autotherapy.

The fourth therapy was the last one where the pelvic floor was loaded only in a horizontal position, which decreases the power of gravitation forces. As in the fifth therapy the area around coccyx was no longer painful, which signalize the release of the pelvic soft tissues, it was time to start activating it.

The primary function of the pelvic floor is in a vertical position. As an optimal base support is essential for any function in vertical pose, we started with The Sensomotoric Stimulation, foot support optimization and Alphabet for Our Feet by Clara Lewitová (Lewitová, 2016) to prepare the feet. Gradually more posturally demanding positions were added to find the most difficult one in which the patient can consciously engage and maintain the pelvic floor activation without triggering the superficial layers, such as perineal muscles and m. rectus abdominis. In this position, the patient then trained to maintain the activated pelvic floor and ISSS for a more extended period as well as conscious releasing and reactivation. The most challenging position was chosen for the most complex transfer of the pelvic floor function into the physically very demanding daily life activities of the elite athlete. In the fifth therapy, the most optimal position was a mild squat with 30° knees flexion.

In the sixth therapy, the position was further developed to one-leg stand, which was retained for the last seventh therapy and subsequent autotherapies.

As a parameter to assess the efficiency of the therapeutic intervention were used a musculoskeletal assessment, standardized incontinence questionnaires and subjective patient's evaluation.

The musculoskeletal assessment demonstrated release of soft tissues in the pelvic area and improved feet support. All of the standardized incontinence questionnaires had a worse score than at the beginning of the therapy. This result was surprising, given the objective improvement of pelvic floor functionality. However, the patient's subjective assessment of the treatments has cleared the mystery. After therapies, she feels an improvement in the slightly reduced urine leakage, the disappearance of menstrual pain and non-recurrent bladder inflammation. The reason for the worsening of the results in the questionnaires is a much greater awareness of the pelvic floor and processes taking

place there leading to different self-assessment and deeper understanding of questionnaire.

As the peak effect of pelvic floor therapy usually demonstrates after a 6-month treatment, we are not at the peak yet and there still is space to improve. We agreed with the patient to perform the prescribed autotherapy and continue with therapies in case of a non-changing or worsening state.

Although many studies (Da Roza et al., 2015b; Gram & Bø, 2019; Thyssen et al., 2002) found a high prevalence of urinary incontinence in elite athletes, yet there is no statistical work on the effectiveness of physiotherapy as primary, secondary or tertiary prevention or treatment in this specific group. However, Berghmans et al. (2020) classify physiotherapy as a first-line therapy.

Several works (Deffieux et al., 2013; Dumoulin et al., 2016; Robert & Ross, 2018; Singh et al., 2015; Wein, 2015) demonstrated the positive effect of conservative therapy in urinary incontinence treatment in wider female groups.. Since this thesis explored the impact of individual physiotherapy in one patient, it makes little sense to compare it with other work focusing on statistical analysis.

7 CONCLUSION

Urinary incontinence in female athletes is a frequent issue. The aim of this thesis was to summarize theoretical knowledge about urinary incontinence and use the insight in practical application of physiotherapy in elite female athlete.

The theoretical part is focused on the anatomy and physiology of the lower urinary tract and pelvic floor, description of urinary incontinence, its types, diagnostic and conservative therapy options.

In the physiotherapy, the primary attention was paid to pelvic floor muscle awareness, its conscious activation and relaxation. As a result, the patient's condition improved. However, it has not been entirely resolved and it is advisable to continue autotherapy and therapy.

Future studies and mainly practice could fruitfully explore this issue further by focusing on possibilities of prevention in sports with high UI prevalence and optimal treatment. Further studies with a larger sample of patients are also recommended. This topic should no longer be a taboo, but be part of the overall care of any woman.

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LIST OF ATTACHMENTS

Attachment 1: Contlife questionnaire (Amarenco et al., 2003)

Record Identification

Centre n° ___ Patient n° ___

First 2 letters of the patient's surname ___

First letter of the patient's first name _

Quality of Life Assessment Questionnaire Concerning Urinary Incontinence

How to fill in the questionnaire:

The following questions are about your health over the last 4 weeks.

Choose the answer which best describes what you feel or have felt over the last 4 weeks giving only one answer per line.

If you are not affected by certain activities (e.g.: sports but you do not practise any), put a tick in the "not applicable" box.

Please answer this questionnaire by yourself.

To answer, tick the box which applies to you.
Example: Over the last 4 weeks...

	Not applicable					
Question a	☐ 0	☐ 1	☐ 2	☑ 3	☐ 4	☐ 5

If you make a mistake, cross out the wrong answer and circle the one which best applies to your situation.

We thank you for your cooperation.

➢*Before beginning to fill in the questionnaire, please write in today's date below:*

!__!__! !__!__! !__!__!

Day Month Year

DAILY ACTIVITIES

Over the last 4 weeks, how much have your urinary problems bothered you:

(Tick the box of your choice, one per line)

	Not applicable	Not at all	A little	Moderately	A lot	Extremely
1. when you were away from your home?		☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
2. when you were driving or being a passenger?	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
3. when going up or down stairs?		☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
4. when shopping?		☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
5. when waiting, queuing (bus stop, post office...)?		☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Over the last 4 weeks, because of your urinary problems:

(Tick the box of your choice)

	Not at all	A little	Moderately	A lot	Extremely
6. have you had to take frequent breaks during your work or daily activities?	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Over the last 4 weeks, because of your urinary problems, how often:

(Tick the box of your choice)

	Never	Rarely	Sometimes	Often	All the time
7. have you woken up having wet yourself?	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

EFFORT

Over the last 4 weeks, how much have your urinary problems bothered you:

(Tick the box of your choice, one per line)

	Not applicable	Not at all	A little	Moderately	A lot	Extremely
8. when lifting or carrying heavy objects?		☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
9. when doing sport (running, dancing, keep-fit)?	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
10. when blowing your nose, sneezing or coughing?		☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
11. when you had a fit of laughter?		☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

SELF IMAGE

Over the last 4 weeks, because of your urinary problems, how often:

(Tick the box of your choice, one per line)

	Never	Rarely	Sometimes	Often	All the time
12. have you felt less attractive?	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
13. were you afraid of giving off an unpleasant odour?	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
14. were you afraid that other people might become aware of your problems?	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
15. were you afraid of leaving stains at other people's homes or at work?	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
16. did you have to change your clothes?	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Over the last 4 weeks, in spite of your urinary problems, how often:

(Tick the box of your choice)

	Never	Rarely	Sometimes	Often	All the time
17. have you felt good in yourself?	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Over the last 4 weeks, because of your urinary problems:

(Tick the box of your choice)

	I never wear pads	Not at all	A little	Moderately	A lot	Extremely
18. have you been bothered by having to wear pads?	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

EMOTIONAL CONSEQUENCES

Over the last 4 weeks, because of your urinary problems, how often :

(Tick the box of your choice, one per line)

	Never	Rarely	Sometimes	Often	All the time
19. have you felt discouraged?	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
20. have you lost patience?	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
21. have you been worried that you might have a urinary 'accident'?	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
22. have you had the feeling of not being able to control your emotional reactions?	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
23. have you felt obsessed by your urinary problems?	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
24. did you need to think about taking pads with you before going out?	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

SEXUALITY

Over the last 4 weeks, because of your urinary problems, how much:

(Tick the box of your choice, one per line)

	Not applicable	Not at all	A little	Moderately	A lot	Extremely
25. have you felt anxious at the thought of having sexual intercourse?		☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
26. have you changed your sexual practices?	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
27. have you been afraid of having urine leaks during sexual intercourse?	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

OVERALL QUALITY OF LIFE

28. Taking your urinary problems into account, how would you currently assess your quality of life?

(Circle the answer of your choice)

1	2	3	4	5
Poor				Excellent

Attachment 2: ICIQ-UI SF (International Consultation on Incontinence Questionnaire-Urinary Incontinence Short Form (ICIQ-UI SF), 2014)

Initial number

ICIQ-UI Short Form

CONFIDENTIAL

DAY MONTH YEAR

Today's date

Many people leak urine some of the time. We are trying to find out how many people leak urine, and how much this bothers them. We would be grateful if you could answer the following questions, thinking about how you have been, on average, over the PAST FOUR WEEKS.

1 Please write in your date of birth: DAY MONTH YEAR

2 Are you *(tick one)*: Female ☐ Male ☐

3 How often do you leak urine? *(Tick one box)*

never ☐	0
about once a week or less often ☐	1
two or three times a week ☐	2
about once a day ☐	3
several times a day ☐	4
all the time ☐	5

4 We would like to know how much urine <u>you think</u> leaks.
How much urine do you <u>usually</u> leak (whether you wear protection or not)?
(Tick one box)

none ☐	0
a small amount ☐	2
a moderate amount ☐	4
a large amount ☐	6

5 Overall, how much does leaking urine interfere with your everyday life?
Please ring a number between 0 (not at all) and 10 (a great deal)

0 1 2 3 4 5 6 7 8 9 **10**
not at all — a great deal

ICIQ score: sum scores 3+4+5 ☐☐

6 When does urine leak? *(Please tick all that apply to you)*

never – urine does not leak ☐
leaks before you can get to the toilet ☐
leaks when you cough or sneeze ☐
leaks when you are asleep ☐
leaks when you are physically active/exercising ☐
leaks when you have finished urinating and are dressed ☐
leaks for no obvious reason ☐
leaks all the time ☐

Thank you very much for answering these questions.

Attachment 3: Overactive bladder questionnaire (OAB-q) (Coyne et al., 2002)

This questionnaire asks about how much you have been bothered by selected bladder symptoms during the past 4 weeks. Please circle the number that best describes the extent to which you were bothered by each symptom during the past 4 weeks. There are no right or wrong answers. Please be sure to answer every question.

During the past 4 weeks, how bothered were you by. . .	Not at all	A little bit	Some what	Quite a bit	A great deal	A very great deal
1. Frequent urination during the daytime hours	1	2	3	4	5	6
2. An uncomfortable urge to urinate	1	2	3	4	5	6
3. A sudden urge to urinate with little or no warning	1	2	3	4	5	6
4. Accidental loss of small amounts of urine	1	2	3	4	5	6
5. Nighttime urination	1	2	3	4	5	6
6. Waking up at night because you had to urinate	1	2	3	4	5	6
7. An uncontrollable urge to urinate	1	2	3	4	5	6
8. Urine loss associated with a strong desire to urinate	1	2	3	4	5	6

The above questions asked about your feelings about individual bladder symptoms. For the following questions, please think about your overall bladder symptoms in the past 4 weeks and how these symptoms have affected your life. Please answer each question about how often you have felt this way to the best of your ability. Please circle the number that best answers each question.

9. Made you carefully plan your commute?	1	2	3	4	5	6
10. Caused you to feel drowsy or sleepy during the day?	1	2	3	4	5	6
11. Caused you to plan 'escape routes' to restrooms in public places?	1	2	3	4	5	6
12. Caused you distress?	1	2	3	4	5	6
13. Frustrated you?	1	2	3	4	5	6
14. Made you feel like there is something wrong with you?	1	2	3	4	5	6
15. Interfered with your ability to get a good night's rest?	1	2	3	4	5	6
16. Caused you to decrease your physical activities (exercising, sports, etc.)?	1	2	3	4	5	6
17. Prevented you from feeling rested upon walking in the morning?	1	2	3	4	5	6
18. Frustrated your family and friends?	1	2	3	4	5	6
19. Caused you anxiety or worry?	1	2	3	4	5	6
20. Caused you to stay home more often than you would prefer?	1	2	3	4	5	6
21. Caused you to adjust your travel plans so that you are always near a restroom?	1	2	3	4	5	6
22. Made you avoid activities away from restrooms (i.e., walks, running, hiking)?	1	2	3	4	5	6
23. Made you frustrated or annoyed about the amount of time you spend in the restroom?	1	2	3	4	5	6
24. Awakened you during sleep?	1	2	3	4	5	6
25. Made you worry about odor or hygiene?	1	2	3	4	5	6
26. Made you uncomfortable while traveling with others because of needing to stop for a restroom?	1	2	3	4	5	6
27. Affected your relationships with family and friends?	1	2	3	4	5	6
28. Caused you to decrease participating in social gatherings, such as parties or visits with family or friends?	1	2	3	4	5	6
29. Caused you embarrassment?	1	2	3	4	5	6
30. Interfered with getting the amount of sleep you needed?	1	2	3	4	5	6
31. Caused you to have problems with your partner or spouse?	1	2	3	4	5	6
32. Caused you to plan activities more carefully?	1	2	3	4	5	6
33. Caused you to locate the closest restroom as soon as you arrive at a place you have never been?	1	2	3	4	5	6

Attachment 4: Informed Agreement

Informed Agreement

Informed Agreement for Participation in a Case Report of the Bachelor's thesis

Name of the university and adress:	Masaryk university, Faculty of Sports Studies, Kamenice 5, 625 00, Brno
Student's name:	Bc. Veronika Körnerová
Student's identification number (UČO):	435001
Study programme:	Physiotherapy
Title of bachelor 's thesis:	Physiotherapy in Patients with Urinary Incontinence
Supervisor:	Mgr. Michaela Bobrová

Participant's name: **Date of Birth:**

1. By signing this form, I agree with the participation in a case report of the Bachelor´s thesis.

2. I was informed about the aim of this thesis and its case report and particular expectations from my participation. I am aware of the research purpose of this study. I understand that my participation in the study is voluntary and I may choose not to participate and withdraw my consent to participate at any time. I will not be penalized in any way.

3. My personal data in the study will be fully protected according to the applicable regulations and laws of the Czech Republic. The protection of my data confidentiality is completely guaranteed. In the course of the study itself, personal data may be provided to other than the above-mentioned entities only without identification data (anonymous) data. Also, for research and scientific purposes, my personal data may be provided only without identification data (anonymous data) or only with my explicit consent.

4. There is no reward associated with my participation in the study.

5. I understand that my name will never be in further possible papers, cites, reviews, etc. about this study. On the contrary, I will not oppose the use of the results of this study.

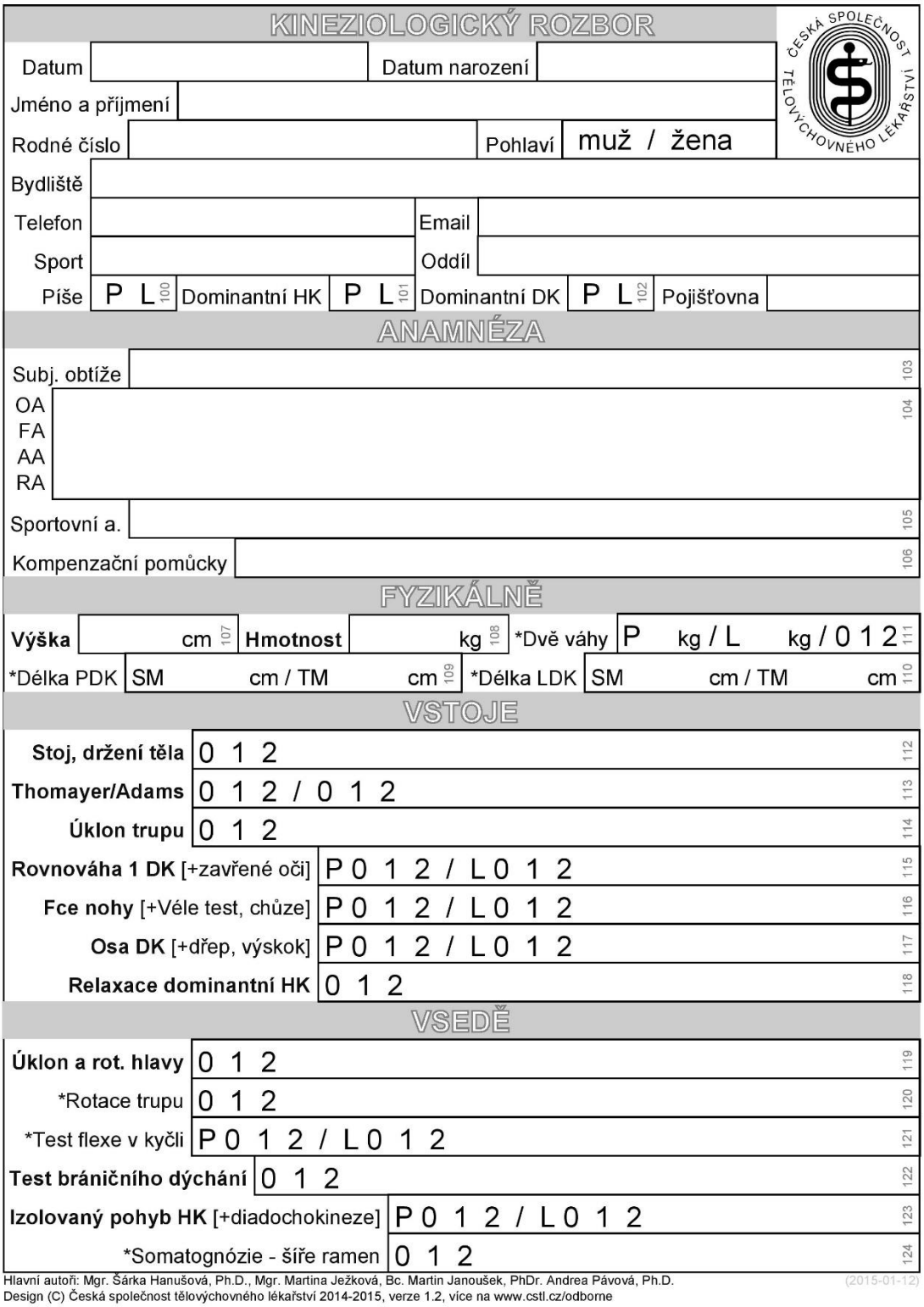
I have read this consent form and have been given the opportunity to ask questions. I give my consent to participate in this study.

Participant′s signature:

Signature of the physiotherapist responsible for this study:

Date:

Attachment 5: Kinesiological analysis form



KINEZIOLOGICKÝ ROZBOR

ČESKÁ SPOLEČNOST TĚLOVÝCHOVNÉHO LÉKAŘSTVÍ

Datum		Datum narození	
Jméno a příjmení			
Rodné číslo		Pohlaví	muž / žena
Bydliště			
Telefon		Email	
Sport		Oddíl	
Píše	P L 100	Dominantní HK	P L 101
Dominantní DK	P L 102	Pojišťovna	

ANAMNÉZA

Subj. obtíže	103
OA FA AA RA	104
Sportovní a.	105
Kompenzační pomůcky	106

FYZIKÁLNĚ

Výška	cm 107	**Hmotnost**	kg 108	*Dvě váhy	P kg / L kg / 0 1 2 111
*Délka PDK	SM cm / TM cm 109	*Délka LDK	SM cm / TM cm 110		

VSTOJE

Stoj, držení těla	0 1 2	112
Thomayer/Adams	0 1 2 / 0 1 2	113
Úklon trupu	0 1 2	114
Rovnováha 1 DK [+zavřené oči]	P 0 1 2 / L 0 1 2	115
Fce nohy [+Véle test, chůze]	P 0 1 2 / L 0 1 2	116
Osa DK [+dřep, výskok]	P 0 1 2 / L 0 1 2	117
Relaxace dominantní HK	0 1 2	118

VSEDĚ

Úklon a rot. hlavy	0 1 2	119
*Rotace trupu	0 1 2	120
*Test flexe v kyčli	P 0 1 2 / L 0 1 2	121
Test bráničního dýchání	0 1 2	122
Izolovaný pohyb HK [+diadochokineze]	P 0 1 2 / L 0 1 2	123
*Somatognózie - šíře ramen	0 1 2	124

Hlavní autoři: Mgr. Šárka Hanušová, Ph.D., Mgr. Martina Ježková, Bc. Martin Janoušek, PhDr. Andrea Pávová, Ph.D. (2015-01-12)

VLEŽE NA ZÁDECH

*Břišní reflexy	0 1 2			201
Flekční test	0 1 2			202
Test vzpažení	0 1 2	203	*Test břišního lisu	0 1 2	204
Rotace (VR, ZR) v kyčli	/			205
*Stereognózie stehna (1K4R6)	P 0 1 2 / L 0 1 2			206
Izolovaný pohyb DK	P 0 1 2 / L 0 1 2			207
*Koleno (vazy, menisky)	P 0 1 2 / L 0 1 2			208

VLEŽE NA BŘIŠE

*Stereognózie zad	P 0 1 2 / L 0 1 2	209
Test extenze trupu	0 1 2	210

OSTATNÍ

Test na čtyřech	0 1 2	211	*Beighton score	212
Palpační nález				213
*Ostatní				214

SOUHRN

Stabilizační fce trupu	0 1 2	215
Stabilizační fce pletence ramenního	0 1 2	216
Stabilizační fce DK a nohy	0 1 2	217
Gnostické a koordinační funkce	0 1 2	218
*Jiné		219
Závěr		220
Doporučení		221

Fyzioterapeut		Podpis	
Pracoviště			