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Cutting-Edge Approaches in Urinary Incontinence Treatment: A Comprehensive Review

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Abstract

Introduction: Urinary incontinence is a prevalent health issue that profoundly impacts the quality of life for patients worldwide. Traditional treatments, including pharmacotherapy and surgical procedures, often fall short, leaving many individuals struggling with bladder control issues that restrict physical and social activities and cause significant psychological distress. Recent advancements in therapeutic methods—encompassing behavioral therapies, cutting-edge medical technologies, innovative pharmacotherapy, and advanced surgical techniques—offer promising alternatives. By exploring the effectiveness and advantages of these novel approaches, we can enhance treatment accessibility and elevate the quality of care for those affected by urinary incontinence, ultimately improving their daily functioning and overall well-being.

Aim: The aim of this article is to review the latest scientific advancements in the treatment of urinary incontinence and their impact on enhancing patients' quality of life. This review will cover cutting-edge treatment methods, including behavioral therapies, innovative medical technologies, advanced pharmacotherapy, and surgical procedures. Additionally, the article will provide a critical analysis of current scientific data and explore future research directions and therapeutic developments. By doing so, we aim to offer valuable insights into the evolving landscape of urinary incontinence treatment and its potential to significantly improve patient outcomes.

Review methods: This article is based on a comprehensive, non-systematic review of the scientific literature, focusing on the following keywords: Urinary incontinence, Treatment methods, Behavioral therapy, Pharmacotherapy, Surgical procedures, Regenerative medicine, Quality of life, Pelvic floor muscle training, Neuromodulation, Biomaterials, and Innovations. A thorough search of the PubMed database was conducted, and 31 sources published up to 2023 were analyzed to ensure that the information presented is current and relevant. This approach was designed to provide a thorough overview of the latest advancements in urinary incontinence treatment and their potential to enhance patient quality of life.

Abbreviated description of the state of knowledge: Current research on innovative treatments for urinary incontinence indicates significant advancements in enhancing patients' quality of life. These cutting-edge methods encompass behavioral therapies like pelvic floor muscle training, state-of-the-art medical technologies such as nerve stimulation, new pharmacological treatments with high efficacy and minimal side effects, and advanced surgical interventions, including artificial sphincter implants and urinary tract modifications. Despite

these promising developments, further research is essential to thoroughly evaluate their effectiveness and long-term benefits.

Conclusions: Urinary incontinence is a prevalent health issue that significantly deteriorates the quality of life, particularly affecting half of women and one-third of men over the age of 80. As our society ages and the number of individuals affected by this condition rises, understanding and advancing treatment methods become increasingly crucial. Ongoing research aims to discover new and improved therapeutic approaches with minimal side effects, offering hope for enhanced patient outcomes and better management of urinary incontinence in the future.

Keywords: Urinary incontinence, Treatment methods, Behavioral therapy, Pharmacotherapy, Surgical procedures, Regenerative medicine, Quality of life, Pelvic floor muscle training, Neuromodulation, Biomaterials;

Introduction:

Urinary incontinence is a widespread health issue impacting millions globally, regardless of age, gender, or socioeconomic status. This condition not only diminishes the quality of daily life but also leads to significant physical, mental, and social repercussions. Despite the availability of traditional treatments like pharmacotherapy and surgical procedures, many patients continue to struggle with bladder control, resulting in restricted physical and social activities and considerable psychological distress.

In recent years, there has been a rapid development of innovative therapeutic methods, including behavioral therapies, advanced medical technologies, novel pharmacotherapy, and cutting-edge surgical procedures. These new approaches present numerous challenges for scientists and healthcare professionals in urology and rehabilitation, particularly in evaluating their effectiveness, safety, and impact on patients' quality of life.

This article aims to review the latest scientific research on how these new treatments for urinary incontinence can improve patients' quality of life. We will explore the most recent advancements in behavioral therapies, medical technologies, pharmacotherapy, and invasive surgical procedures, providing a critical analysis of the current scientific data and perspectives for future research and therapeutic development.

By gaining a comprehensive understanding of the effectiveness and benefits of these innovative treatment methods, we can enhance the availability and quality of care for patients with urinary incontinence, ultimately contributing to their improved daily functioning and overall well-being.

Urinary Incontinence

Urinary incontinence (UI), i.e. loss of control over urination, is a common problem, especially among older people. Most epidemiological studies confirm that urinary incontinence (UI) is prevalent in women, occurring in the range of 25% to 45%, while in men, though less frequent, it is present in percentages ranging from 5% to 35%. The Epidemiology of Incontinence (EPIC) study observed an increase in the frequency of urinary incontinence from 2.4% in men under the age of 39 to 10.4% in those over 60 years of age, and in women from 7.3% to 19.3% [1]. Beyond the age of 80, half of women and one-third of men experience urinary incontinence [2]. The International Continence Society (ICS) has identified the following types of UI:

Overactive bladder (OAB): Characterized by a sudden urge to urinate, often accompanied by frequent urination during the day and nocturia, with or without sudden urinary incontinence, in the absence of urinary tract infection or other obvious pathologies in the lower urinary tract (e.g., bladder stones, bladder cancer, neurological diseases, or severe pelvic floor disorders);

Stress urinary incontinence (SUI): Characterized by uncontrolled urine leakage during physical activities such as sneezing, coughing, running or lifting weights. The severity of SUI varies, ranging from isolated droplets during significant exertion to urine leakage during normal walking or even at rest. The Stamey scale can be used to determine the degree of SUI:

- **I degree** – leakage of urine only during a rapid and significant increase in intra-abdominal pressure;
- **II degree** - involuntary urination during a moderate increase in intra-abdominal pressure - when walking up the stairs, jumping up, and light physical work
- **III degree** – leakage of urine while lying down, standing, or walking;

Urinary incontinence from overflow: This is the uncontrolled leakage of urine, independent of the patient's will. It is caused by impaired detrusor contractility and/or bladder outlet obstruction, resulting in an overly distended urinary bladder. This may be caused by urinary flow obstruction due to conditions such as benign prostatic hyperplasia, pelvic or abdominal tumors, spinal cord injury, diabetes, or multiple sclerosis [2, 3].

Extra-sphincteric inextra-sphincteric incontinence (NM): may result from the presence of fistulas or developmental abnormalities [4, 5, 6]. In this type, urine leakage does not occur through the external urethral orifice but through another pathway. It can occur in cases of vesicourethral fistulas [7].

Overview of treatment methods

The initial approach in addressing urinary incontinence, especially in treating stress urinary incontinence is conservative management. This strategy encompasses a range of interventions such as physical therapies, behavior modification techniques and pharmacological interventions [8]. Another options are three FDA-approved treatments tailored for women experiencing persistent urgency incontinence symptoms or those exhibiting intolerance to medications. Those treatments are: injection of onabotulinum toxin A, sacral neuromodulation and posterior tibial nerve stimulation [9]. If those methods are insufficient surgery is an option [10].

1. Behavioral therapy:

Studies showed that regular and progressive pelvic floor muscle training (PFMT) is effective in reducing symptoms of urinary incontinence. Electromyographic biofeedback, weighted vaginal cones and electrical stimulation can enhance the effects of PFMT [11]. Regular activation of weakened muscle fibers improves their coordination, thereby increasing urethral compression during increased intra-abdominal pressure, such as during exercise. Proper

execution of pelvic floor exercises, especially during sensorimotor training sessions, facilitates the restoration of proprioception in the levator ani muscles [12].

Engaging in pelvic floor muscle training can effectively alleviate symptoms and enhance the quality of life for individuals experiencing various types of urinary incontinence. Moreover, there is moderate to high certainty evidence suggesting that the effectiveness of these exercises is heightened when they are performed with greater intensity, under the supervision of a healthcare professional. Weight management and bladder emptying control, may prove beneficial for certain types of urinary incontinence [13].

2. Pharmacotherapy:

Antimuscarinics and β 3-agonist medications are used as a second-line option of therapy. Mechanism of action of antimuscarinics is to block the muscarinic receptors, which are located in the urinary bladder. Their function is to simplify the voiding phase of urination by retracting the detrusor smooth muscle [14]. Common side effects associated with using antimuscarinics (also known as anticholinergic drugs) are: dry mouth, blurred vision, constipation. Geriatric patients are more prone to experience symptoms from central nervous system such as: sedation, delirium, trouble with concentration [15]. Long-term use of has been linked to the occurrence of dementia [16]. Examples of anticholinergic drugs used to treat UI are: oxybutynin, tolterodine, darifenacin, trospium, solifenacin [17]. β 3-agonists goal is to enhance the relaxation of detrusor smooth muscle in the storage phase [14]. Mirabegron is a β 3-agonists of choice when treating patients with UI. The most common side effects while using this drug are: elevated blood pressure, headache, urinary tract infections [18]. Duloxetine which is inhibitor of serotonin and norepinephrine reuptake is a drug approved for treating SUI in Europe. The possible mechanism of action is facilitating the bladder-to-sympathetic reflex pathway, thereby increasing the tone of the urethral and external urethral sphincter muscles during the storage phase [19]. While taking duloxetine patients may experience gastrointestinal and central nervous systems side effects [20]. Vaginal estrogen can be good choice for women with vaginal atrophy and symptoms of UI [21].

3. New technologies:

Techniques such as intravesical Onabotulinum toxin A (oBTXA), sacral neuromodulation, and posterior tibial nerve stimulation are third-line options in cases of intolerance or insufficient current treatment.

Injection of oBTXA into the bladder wall is recommended in patients who have not responded to previous conservative and drug treatment. The toxin is injected into the growth muscle using a cystoscope. Although BTXA has been shown to have better outcomes in the treatment of UUI compared to SNS in studies, the clinical significance remains unclear, especially due to the side effects of oBTXA which include urinary tract infection (UTI), urinary retention, and incomplete bladder emptying [22].

Sacral neuromodulation (SNM) is a treatment method that involves placing an electrode in the third sacral foramen (S3). The electrode electrically stimulates the nerve root, suppressing

the reflexes responsible for involuntary discharge contractions. SNS may be recommended for people who have failed conservative and pharmacological treatment. SNS treatment of UUI symptoms in OAB is safe and effective in both the short and long term [23].

Percutaneous tibial nerve stimulation (PTNS) is a method of stimulating the sacral nerve plexus by percutaneously placing a needle in the posterior tibial nerve peripherally for approximately 0.5 hour per week for a period of 12 weeks. The preliminary results for PTNS are encouraging, but unfortunately there are no long-term follow-up results for an objective evaluation [24].

4. Surgical treatment methods

Surgical methods of treating urinary incontinence may be considered in cases where other therapeutic methods have not yielded satisfactory results. The need to use surgical methods also depends on the severity of urinary incontinence symptoms, the impact of these symptoms on the patient's quality of life, and the patient's individual preferences and needs.

Inside-out transobturator tape (tension-free vaginal tape-obturator [TVT-O]) is a technique that uses synthetic, tension-free tapes inserted under the middle section of the urethra via a transvaginal, retropubic or obturator approach. The method is often preferred in patients with symptoms of stress urinary incontinence who do not respond to behavioral or pharmacological therapies. During the procedure, a small incision is made in the vaginal tissues to gain access to the middle section of the urethra. A synthetic tape is inserted under the urethra and positioned to support its sphincter function. The advantages of this method are shorter recovery time and lower risk of complications due to the low invasiveness of the procedure. Despite the effectiveness of the method, some patients may still experience urinary incontinence after surgery [25].

Abdominal retropneal suspension- Burch's colposuspension is a method used to treat stress urinary incontinence, especially when it is associated with hypermobility of the urethra. It involves retropubic suspension of the side walls of the vagina to the ilioinguinal ligament using sutures from a laparoscopic or open approach. This technique improves the stability of the bladder and sphincter, which leads to a reduction in the symptoms of urinary incontinence. Currently, Burch colposuspension remains an option for secondary treatment as recommended. However, it is an effective and safe treatment method [26].

Sling surgery - involves inserting the bladder under the neck and supporting it with a strap made of the patient's own fascia (the natural fascia of the rectus muscle or fascia lata) or made of an artificial material. The most commonly used approach is the combined retropubic and transvaginal approach. This method is highly effective, but also has the highest risk of complications such as iatrogenic hyper-reactivity and post-void urine retention [27].

Artificial urinary sphincter (AUS) – AUS is considered the standard treatment for severe SUI. Based on the insertion paradigm, two types of AUS can be identified: extraurethral and intraurethral paradigms. Extraurethral AUS is currently considered the gold standard treatment

for urinary incontinence. It is a silicone sphincter prosthesis consisting of a hydraulic cuff surrounding the urethra, connected to an expansion tank containing fluid, and a pump pumping the fluid into the cuff (urethral closure) and emptying it (urethral open, micturition).

The main disadvantages of these devices include non-mechanical failures due to tissue atrophy, erosion and infections, difficulties in management due to manual control of the occlusion mechanism, and the high invasiveness of the components. Intraurethral AUS is currently a promising method because it is minimally invasive yet effective. The development of an ideal AUS could fully restore the quality of life of patients with urinary incontinence, but long-term stability resulting from contact with urine remains a challenge [28].

Urethral bulking agents and balloon implants - They are much less effective than other methods. They involve endoscopic (trans- or periurethral) injection of a sealing substance submucosally into the area of the urinary bladder neck. Many materials are used in the method. Currently, the most commonly used are: bovine collagen, a suspension of silicone microimplants, pyrolytically carbon-coated zirconium oxide microspheres, and a copolymer of dextranomer and hyaluronic acid. The disadvantages of the method are frequent migration of the preparation, allergies, tissue erosion and cost [29].

In those refractory to all treatments, augmentation cystoplasty or urinary diversion are the final options.

5. Regenerative medicine

The use of mesenchymal stem cells (MSCs) in the treatment of stress urinary incontinence seems to be a promising treatment method. A review of the literature suggests that stem cell-based therapy may have the potential to improve pelvic floor muscle function and control urine leakage in patients with stress urinary incontinence. MSCs used in regenerative medicine come mainly from muscle, adipose tissue or bone tissue. A common feature regardless of MSC origin is the maintenance of undifferentiated properties, multilineage differentiation capacity, long-term replication and self-renewal potential. Isolated cells are normally suspended in media supporting the amplification of the required cell type. Before injection, the cells are suspended in a scaffold, for example based on collagen, together with autologous serum. In studies, the therapy produced acceptable functional results with minimal side effects and complications. However, further clinical trials are needed to confirm the effectiveness of this therapy and to determine optimal treatment protocols and long-term outcomes [30,31].

The impact of new treatment methods on the quality of life of patients

Modern methods of treating urinary incontinence significantly contribute to improving the quality of life for patients affected by this condition. The first aspect is the effectiveness of new methods, which often provide better results compared to traditional forms of therapy. Thanks to advancements in the field of medicine, patients have access to more precise diagnostic tools and innovative therapeutic procedures, resulting in the effective alleviation of urinary incontinence symptoms. Modern methods often emphasize the individualization of therapy, allowing it to be tailored to the specific needs of each patient. The significant impact lies in the

reduction of urine frequency, the decrease in sudden urges to void the bladder, and the prevention of involuntary urine leakage, for example, during physical activities [19].

Psychosocial aspects of life are also significant, such as a meaningful change in the quality of life.

Patients with well-controlled urinary incontinence regain confidence, self-acceptance, and experience positive changes in emotional well-being. Improvement in control over urinary incontinence translates into increased self-confidence and autonomy, which is of significant importance for the quality of life. Further development and implementation of innovative solutions in this field contribute to raising the standards of care for patients with urinary incontinence [4].

Future research directions

Future research directions in urinary incontinence encompass a range of areas aimed at expanding knowledge, developing effective therapies, and enhancing the quality of patient care. Potential research areas worth focusing on include innovative therapies, personalized treatment approaches, precise diagnostics, monitoring technologies for urinary incontinence-related parameters to better understand and counteract the phenomenon [30]. Understanding risk factors and patient education and awareness are also important. In the future, research on new therapies, such as gene and cell therapies, and the application of advanced medical technologies, will play a key role [31]. Additionally, emphasis on developing more precise diagnostic methods, such as molecular imaging and biomarkers, is essential for faster and more accurate identification of the causes of urinary incontinence.

Summary:

New methods of treating urinary incontinence significantly enhance patients' quality of life by alleviating physical symptoms and improving emotional and psychosocial well-being. However, further research is crucial to fully understand the long-term effects of these treatments and their effectiveness across diverse patient groups. Integrating these innovative methods into clinical practice can offer substantial benefits, improving both quality of life and overall well-being for individuals suffering from this condition.

Modern approaches to treating urinary incontinence demonstrate higher effectiveness compared to traditional therapies. Advances in medicine have provided patients with access to more precise diagnostic tools and innovative therapeutic procedures, effectively mitigating symptoms. Key research areas now focus on cutting-edge therapies, personalized treatment strategies, precise diagnostics, and monitoring technologies specific to urinary incontinence, aiming to better understand and counteract this condition. Additionally, it is essential to investigate risk factors, enhance patient education, and raise awareness to ensure comprehensive management and prevention of urinary incontinence.

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References:

1. Shaw C, Wagg A. Urinary and faecal incontinence in older adults. *Medicine*. 2020 Nov;49(1). <https://doi.org/10.1016/j.mpmed.2020.10.012>
2. Drabczyk R. Nietrzymanie moczu - rodzaje, leczenie i sposoby zapobiegania. www.mp.pl. 2022. Available from: <https://www.mp.pl/pacjent/nefrologia/choroby/chorobyudoroslych/57804>

3. Tran LN, Puckett Y. Urinary Incontinence. 2023 Aug 8. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. PMID: 32644521.
4. Jankowska-Zych E. Diagnosis and assessment of stress urinary incontinence in women. *Aesth Cosmetol Med.* 2023;12(2):51-55. <https://doi.org/10.52336/acm.2023.005>
5. O'Kane M, Robinson D, Cardozo L, Wagg A, Abrams P. Mirabegron in the Management of Overactive Bladder Syndrome. *Int J Womens Health.* 2022 Sep 16;14:1337-1350. PMID: 36147890; PMCID: PMC9487925. <https://doi.org/10.2147/IJWH.S372597>
6. Rechberger T, Rechberger E. Jak leczyć nietrzymanie moczu. *Lekarz POZ.* 2022;8(2):121-129.
7. Dębiński P, Niezgoda T. Klasyfikacja nietrzymania moczu i sposoby leczenia. *Przegląd Urologiczny* 2014/5 (87).
8. Alouini S, Memic S, Couillandre A. Pelvic Floor Muscle Training for Urinary Incontinence with or without Biofeedback or Electrostimulation in Women: A Systematic Review. *Int J Environ Res Public Health.* 2022 Feb 27;19(5):2789. PMID: 35270480; PMCID: PMC8910078. <https://doi.org/10.3390/ijerph19052789>
9. Russo E, Caretto M, Giannini A, et al. Management of urinary incontinence in postmenopausal women: An EMAS clinical guide. *Maturitas.* 2021 Jan;143:223-230. Epub 2020 Sep 30. PMID: 33008675. <https://doi.org/10.1016/j.maturitas.2020.09.005>
10. Clark L, Fitzgerald B, Noble S, et al. Proper understanding of recurrent stress urinary incontinence treatment in women (PURSUIT): a randomised controlled trial of endoscopic and surgical treatment. *Trials.* 2022 Aug 3;23(1):628. PMID: 35922823; PMCID: PMC9347071. <https://doi.org/10.1186/s13063-022-06546-9>
11. Hagen S, Elders A, Stratton S, et al. Effectiveness of pelvic floor muscle training with and without electromyographic biofeedback for urinary incontinence in women: multicentre randomised controlled trial. *BMJ.* 2020 Oct 14;371:m3719. PMID: 33055247; PMCID: PMC7555069. <https://doi.org/10.1136/bmj.m3719>
12. Radziwińska A, Strączyńska A, Weber-Rajek M, et al. The impact of pelvic floor muscle training on the quality of life of women with urinary incontinence: a systematic literature review. *Clin Interv Aging.* 2018 May 17;13:957-965. PMID: 29844662; PMCID: PMC5962309. <https://doi.org/10.2147/CIA.S160057>
13. Todhunter-Brown A, Hazelton C, Campbell P, et al. Conservative interventions for treating urinary incontinence in women: an Overview of Cochrane systematic reviews. *Cochrane Database Syst Rev.* 2022 Sep 2;9(9):CD012337. PMID: 36053030; PMCID: PMC9437962. <https://doi.org/10.1002/14651858.CD012337.pub2>
14. Denisenko AA, Clark CB, D'Amico M, et al. Evaluation and management of female urinary incontinence. *Can J Urol.* 2021 Aug;28(S2):27-32. PMID: 34453426.
15. Bardsley A. An overview of urinary incontinence. *Br J Nurs.* 2016 Oct 13;25(18):S14-S21. PMID: 27734727. <https://doi.org/10.12968/bjon.2016.25.18.S14>

16. Game X, Dmochowski R, Robinson D. Mixed urinary incontinence: Are there effective treatments? *Neurourol Urodyn.* 2023 Feb;42(2):401-408. Epub 2022 Oct 23. PMID: 36762411; PMCID: PMC10092712. <https://doi.org/10.1002/nau.25065>
17. Wojcik M, Jarzabek-Bielecka G, Merks P, et al. The role of visceral therapy, Kegel's muscle, core stability and diet in pelvic support disorders and urinary incontinence - including sexological aspects and the role of physiotherapy and osteopathy. *Ginekol Pol.* 2022;93(12):1018-1027. PMID: 36602196. <https://doi.org/10.5603/GP.a2022.0136>
18. Shih E, Hirsch H, Thacker HL. Medical management of urinary incontinence in women. *Cleve Clin J Med.* 2017 Feb;84(2):151-158. PMID: 28198687. <https://doi.org/10.3949/ccjm.84a.16054>
19. MacLachlan LS, Rovner ES. New treatments for incontinence. *Adv Chronic Kidney Dis.* 2015 Jul;22(4):279-88. PMID: 26088072. <https://doi.org/10.1053/j.ackd.2015.03.003>
20. Rahnama'i MS, Marcelissen T, Geavlete B, et al. Current Management of Post-radical Prostatectomy Urinary Incontinence. *Front Surg.* 2021 Apr 9;8:647656. PMID: 33898508; PMCID: PMC8063855. <https://doi.org/10.3389/fsurg.2021.647656>
21. McKinney JL, Keyser LE, Pulliam SJ, et al. Female Urinary Incontinence Evidence-Based Treatment Pathway: An Infographic for Shared Decision-Making. *J Womens Health (Larchmt).* 2022 Mar;31(3):341-346. Epub 2021 Nov 5. PMID: 34747662; PMCID: PMC8972010. <https://doi.org/10.1089/jwh.2021.0266>
22. Chancellor MB, Elovic E, Esquenazi A, et al. Evidence-based review and assessment of botulinum neurotoxin for the treatment of urologic conditions. *Toxicon.* 2013;67:129-140. doi:10.1016/j.toxicon.2013.01.020
23. Feloney MP, Stauss K, Leslie SW. Sacral Neuromodulation. In: *StatPearls. Treasure Island (FL): StatPearls Publishing; May 30, 2023.*
24. Agost-González A, Escobio-Prieto I, Pareja-Leal AM et al. Percutaneous versus Transcutaneous Electrical Stimulation of the Posterior Tibial Nerve in Idiopathic Overactive Bladder Syndrome with Urinary Incontinence in Adults: A Systematic Review. *Healthcare (Basel).* 2021;9(7):879. Published 2021 Jul 13. doi:10.3390/healthcare9070879
25. Serati M, Braga A, Athanasiou S, et al. Tension-free Vaginal Tape-Obturator for Treatment of Pure Urodynamic Stress Urinary Incontinence: Efficacy and Adverse Effects at 10-year Follow-up. *Eur Urol.* 2017;71(4):674-679. doi:10.1016/j.eururo.2016.08.054
26. Veit-Rubin N, Dubuisson J, Ford A, et al. Burch colposuspension. *Neurourol Urodyn.* 2019;38(2):553-562. doi:10.1002/nau.23905
27. Blaiwas JG, Simma-Chiang V, Gul Z, et al. Surgery for Stress Urinary Incontinence: Autologous Fascial Sling. *Urol Clin North Am.* 2019;46(1):41-52. doi:10.1016/j.ucl.2018.08.014
28. Marziale L, Lucarini G, Mazzocchi T, et al. Artificial Sphincters to Manage Urinary Incontinence: A Review. *Artif Organs.* 2018;42(9):E215-E233. doi:10.1111/aor.13164

29. Kirchin V, Page T, Keegan PE, et al. Urethral injection therapy for urinary incontinence in women. *Cochrane Database Syst Rev.* 2017 Jul 25;7(7):CD003881. doi: 10.1002/14651858.CD003881.pub4. PMID: 28738443; PMCID: PMC6483304.
30. Barakat B, Franke K, Schakaki S, et al. Stem cell applications in regenerative medicine for stress urinary incontinence: A review of effectiveness based on clinical trials. *Arab J Urol.* 2020;18(3):194-205. Published 2020 Apr 17. doi:10.1080/2090598X.2020.1750864
31. Hillary CJ, Roman S, MacNeil S, et al. Regenerative medicine and injection therapies in stress urinary incontinence [published correction appears in *Nat Rev Urol.* 2020 Nov;17(11):650]. *Nat Rev Urol.* 2020;17(3):151-161. doi:10.1038/s41585-019-0273-4