The Role of Pelvic Floor Muscles in Male Sexual Dysfunction and Pelvic Pain

Deborah Cohen, PT, MS, CSCS, COMT, WCS,[1] Joshua Gonzalez, MD,[2,3] and Irwin Goldstein, MD[2]

ABSTRACT

Introduction: Sexual function is essential to good health and well-being in men. The relationship between male sexual function, pelvic floor function, and pelvic pain is complex and only beginning to be appreciated.

Aim: The objectives of the current review are to examine these complex relationships, and to demonstrate how pelvic floor physical therapy can potentially improve the treatment of various male sexual dysfunctions, including erectile dysfunction and dysfunction of ejaculation and orgasm.

Methods: Contemporary data on pelvic floor anatomy and function as they relate to the treatment of various male sexual dysfunctions were reviewed.

Main Outcome Measures: Examination of evidence supporting the association between the male pelvic floor and erectile dysfunction, ejaculatory/orgasmic dysfunction, and chronic prostatitis/chronic pelvic pain syndrome, respectively.

Results: Evidence suggests a close relationship between the pelvic floor and male sexual dysfunction and a potential therapeutic benefit from pelvic floor therapy for men who suffer from these conditions.

Conclusion: Pelvic floor physical therapy is a necessary tool in a more comprehensive bio-neuromusculoskeletal-psychosocial approach to the treatment of male sexual dysfunction and pelvic pain.

Sex Med Rev 2016;4:53–62.

Key Words: Sexual dysfunction; Chronic prostatitis; Pelvic pain; Pelvic floor; Male

INTRODUCTION

Sexual dysfunctions are multifactorial and can be caused by a variety of psychological and biologic issues. As it concerns male sexual dysfunctions, most of the sexual medicine research regarding biologic factors has focused on hormonal, neurologic, and/or vascular issues. There has been a dearth of sexual medicine research on the biologic contribution of pelvic floor disorders to various male sexual dysfunctions. This is in sharp contrast to the large number of studies that have linked pelvic floor disorders in women to female sexual dysfunctions. In fact, pelvic floor therapy is one of several suggested sexual medicine strategies to successfully manage female sexual dysfunctions.[1]

Sexual dysfunctions are highly prevalent in men, increasing with age, and sexual function is regarded by many men as a vital and critical part of their overall health and wellness; moreover, male sexual dysfunctions have been linked to reduced quality of life and negative interpersonal relationships.[2–4] Despite pelvic floor physical therapy representing a conservative, modifiable, noninvasive, nonpharmacologic, and nonsurgical intervention in the treatment of male sexual dysfunction, the biologic relationship between pelvic floor function and male sexual function is seldom emphasized.[5]

To fully appreciate the contributions of the pelvic floor in male sexual function, a basic understanding of its anatomy and physiology is necessary. To standardize terminology, The International Continence Society has proposed the following definitions: The *pelvic floor* is a compound structure that encloses the bony pelvic outlet, consisting of muscle, fascia, and neural tissue, while the term *pelvic floor muscles* refers to the muscular layer of the pelvic floor.[6] These terms are used henceforth accordingly.

There are many examples of the relationship between pelvic floor function/dysfunction and male sexual function/dysfunction. Male pelvic floor dysfunction has been associated with erectile dysfunction as well as dysfunction of ejaculation and orgasm.[7–11] Male pelvic floor muscle training has been shown to increase penile rigidity and penile hardness in some men with erectile dysfunction, potentially facilitating vaginal penetration during thrusting.[12] Shafik described erectile dysfunction caused

Received May 1, 2015. Accepted August 2, 2015.

[1]Fundamental Physical Therapy & Pelvic Wellness, San Diego, CA, USA;
[2]Alvarado Hospital, Department of Sexual Medicine, San Diego, CA, USA;
[3]University of California, Los Angeles, Department of Urology, Los Angeles, CA, USA

http://dx.doi.org/10.1016/j.sxmr.2015.10.001

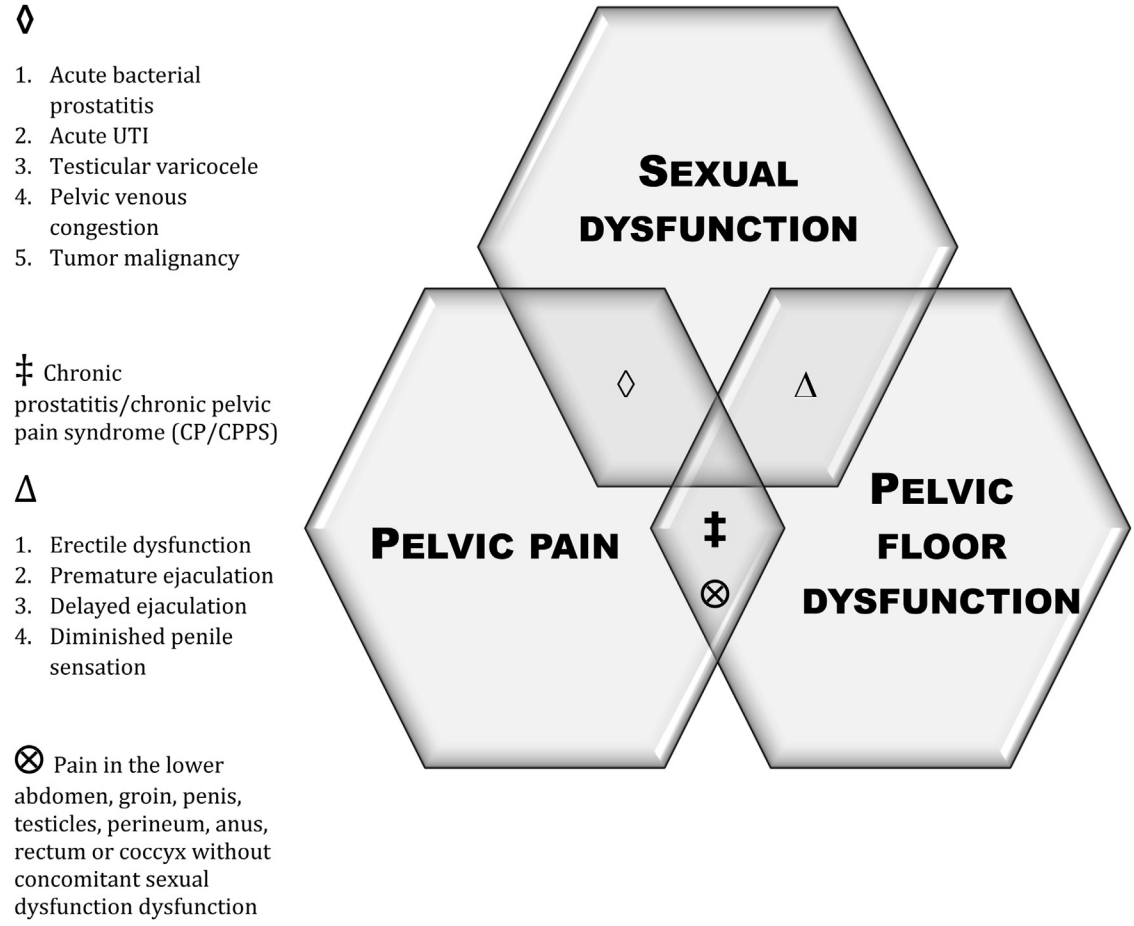

Figure 1. Associations between commonly observed elements of male sexual dysfunction, pelvic floor dysfunction, and pelvic pain.

by a condition called pudendal artery syndrome—a syndrome characterized by decreased internal pudendal blood flow secondary to external compression within the pudendal canal—which is thought to result from pelvic floor muscle dysfunction.[13,14] Male pelvic floor muscle function also is involved in coordinating ejaculation.[12] Pelvic floor therapy has been shown to improve control over ejaculation and allow for increases in intravaginal ejaculatory latency times in men with premature ejaculation and pelvic floor muscle dysfunction.[15] Strong bulbospongiosus (sometimes called bulbocavernosus) contractions may enhance and intensify orgasmic pleasure during ejaculation/orgasm. Improvements in both ejaculation/orgasm and erectile function have been demonstrated with implementation of male pelvic floor treatment plans.[15,16]

Another example of the relationship between pelvic floor dysfunction and male sexual dysfunction has been shown in chronic prostatitis/chronic pelvic pain syndrome (CP/CPPS). This condition is usually associated with problems with urination, defecation, and/or sexual activity. Men with CP/CPPS may experience pain constantly or intermittently, and this pain can occur with sitting, standing, routine daily activity, or sexual activity.[17,18] Effective management of CP/CPPS has been demonstrated in programs that emphasize treatment of pelvic floor dysfunction. Pelvic floor muscle tone, the varying degree of tension within the muscles of the pelvic floor during rest and with activity, is an important factor in CP/CPPS. For example, neuromuscular reeducation with the guidance of electromyography or other methods of biofeedback has been shown to result in reduced resting baseline tone of and improvement in pain scores.[19–24]

The relationship among male sexual dysfunction, pelvic pain, and CP/CPPS is complex, with the 3 conditions often overlapping (Figure 1). The objectives of this literature review are to examine the relationships between the male pelvic floor, male sexual dysfunctions, and CP/CPPS, and to demonstrate how pelvic floor physical therapy can potentially improve the treatment of various male sexual dysfunctions. Attention will be provided to the anatomy and physiology of the pelvic floor and present understanding of how pelvic floor muscle function contributes to male sexual function/dysfunction and to CP/CPPS. Greater understanding of the importance of pelvic floor physical therapy and its implementation alongside available pharmacological treatments will allow a more comprehensive bio-neuromusculoskeletal-psychosocial approach to the treatment of male sexual dysfunction and pelvic pain.

Anatomy and Physiology of the Male Pelvic Floor

The male pelvic floor consists of several tissue layers. Anatomic details of the male pelvic floor are demonstrated in Figure 2.

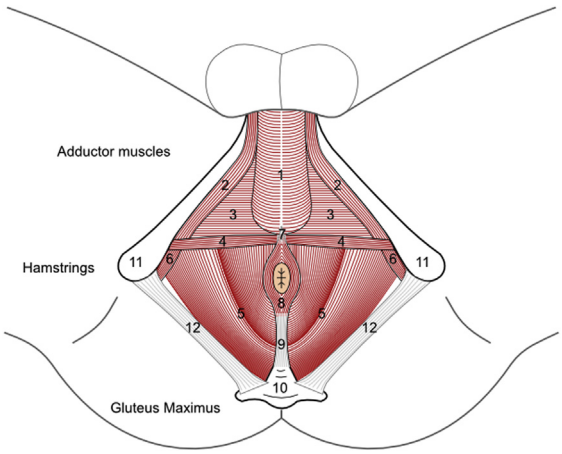

Figure 2. The male pelvic floor, lithotomy view. 1 bulbospongiosus m. 2 ischiocavernosus m. 3 deep transverse perineal m. 4 superficial transverse perineal m. 5 pubococcygeus m. 6 obturator internus m. 7 perineal body 8 external anal sphincter 9 anococcygeal ligament 10 coccyx 11 ischial tuberosities 12 sacrotuberous ligament.

Male pelvic floor function relies on complicated and dynamic relationships between muscle, fascia, ligaments, bone, nerves, and vascular supply that in men play a crucial role in urinary, bowel, and sexual functions. The anatomy and function of the male pelvic floor can be best understood when their relationship to the surrounding bony architecture is appreciated. The bony male pelvis is a ring structure composed of the sacrum and right and left innominates. Each innominate consists of 3 parts: the ilium, ischium, and pubis. The pelvic cavity is divided into the false (greater) and true (lesser) pelvis by the pelvic brim.[25] The male pelvic brim (or inlet) extends from the promontory of the sacrum along the arcuate line of the ilium, pectineal line, and pubic crest. The coccyx is also part of the male bony pelvis, and in most men consists of 5 often fused coccygeal bones that articulate with the sacrum.

The male pelvic floor muscles serve to stabilize its joints when the muscles are active. They extend from the pubic symphysis and rami anteriorly to the coccyx posteriorly and attach laterally to the ischial tuberosities, interior surfaces of the ilia, and the arcus tendineus levator ani. The male pelvic floor muscles function to support the internal organs of the abdomen and pelvis and promote voluntary closure of the urethral and anal sphincters.[12] In order to provide optimal mechanical advantage for these primary functions, the male pelvic floor muscles are arranged in a dome-shaped sheet that contains a complex network of mostly striated muscle that provides cover for the entire pelvic cavity.[26,27] The varied functions of the male pelvic floor are achieved via coordinated activity that involves the full range of contraction, relaxation, and active lengthening, or stretch, of their fibers.

Male pelvic floor muscles are often subdivided into superficial and deeper components, each with particular functions.[25] The male pelvic floor muscles may be described in terms of 3 layers, progressing from superficial (caudal) to deep (cranial) within the pelvic floor.[28]

The most superficial layer (the superficial perineal pouch in men) consists of the bulbospongiosus, ischiocavernosus, superficial transverse perineals, and external anal sphincter. These superficial pelvic floor muscles are important in normal urination and ejaculation and contribute to urinary continence.[29,30] The superficial layer also plays a role in penile rigidity and hardness during erection, as will be discussed later.

The second layer (the urogenital diaphragm) consists of the deep transverse perineals, the sphincter urethrae, and the compressor urethrae. Sometimes referred to as the triangular ligament or the perineal membrane, the urogenital diaphragm is composed of a strong muscular membrane that separates the superficial perineal pouch from the upper pelvis and does not constitute a true diaphragm. The urogenital diaphragm further adds support to urethral closure during increased intra-abdominal pressure and has fascial connections into the deep abdominal musculature, thereby helping stabilize the pelvic and lower lumbar joints during movement.

The third most cranial layer (the pelvic diaphragm) extends from the dorsal aspect of the pubic symphysis to the coccyx and from the interior surface of one ilium to the other.[25] In men, the pelvic diaphragm consists of several muscles including the pubococcygeus (which is composed of the puboruethralis and puborectalis in the male), iliococcygeus, and ischiococcygeus. The pubococcygeus and iliococcygeus collectively are termed the levator ani, as contraction of this deep layer of pelvic floor muscles serves to elevate the anal sphincter. Along with the peritoneal fascia, the pelvic diaphragm is most responsible for supporting the pelvic organs. The tonic activity of the pelvic diaphragm prevents the supportive ligaments of the pelvic organs from becoming overstretched by constant tension.[31] This tonic activity, combined with the limited elasticity of the endopelvic fascia, gives the pelvic diaphragm its characteristic dome shape. However, with pelvic floor dysfunction or laxity, the dome shape can appear more like a basin.[32] The puborectalis is also responsible for controlling the anorectal angle, thereby maintaining anal continence when it is contracted, and allowing for evacuation of the bowels when relaxed.[32] The ischiococcygeus (or simply, coccygeus) does not share functions similar to other pelvic floor muscles (ie, continence, organ support, or sexual function) but is instead responsible for ipsilateral deviation of the coccyx.[31]

The relationship between the puborectalis and levator ani muscles remains controversial. Traditionally it has been thought that the puborectalis constitutes a major component to the levator complex. Using magnetic resonance imaging, Stoker demonstrated that the puborectalis contributes to both the levator ani and external anal sphincter.[32] However, developmental and histological evidence indicate otherwise, suggesting it may be more closely associated with the external anal sphincter.[26] On the other hand, the external anal sphincter is innervated by the inferior rectal branch of the pudendal nerve, whereas the puborectalis and the cranial aspect of the remainder of the levator ani are innervated by the nerve to the levator ani directly.[33] The

disparate innervation may reflect anatomic anomaly but also could imply evolutionary difference between the puborectalis and the levator ani muscles.

Although not officially part of the pelvic floor musculature, the obturator internus is a deep hip external rotator that is anatomically and functionally related to this muscle group. The obturator internus originates from the arcus tendinus levator ani, which is a ligament spanning from the pubic arch anteriorly to the ischial spine posteriorly, and from the obturator membrane covering the obturator foramen.[34,35] It passes through the lesser sciatic foramen to exit the pelvis and inserts on the greater trochanter of the femur, producing hip external rotation when it contracts. Because its origins are from fascial components of the pelvic floor as well as being a stabilizer of the hip, contraction of the obturator internus shortens and elevates the pelvic floor, probably contributing to stiffness of the pelvic joints and allowing support of the pelvic organs.[35] The obturator internus is innervated by the nerve to the obturator internus (L5, S1).[36] Of importance also is the fact that the fascia of the obturator internus gives rise to Alcock's canal, an anatomic tunnel through which the pudendal nerve passes on its tortuous path after entering the pelvis posteriorly through the lesser sciatic foramen and passing anteriorly to give off its branches to the pelvic floor anal saddle region.[37] The presence of spasm or myofascial shortening in the obturator internus is commonly present with intra- or extra-articular hip pathology and, as will be discussed later, is a contributor to pudendal nerve pathology and sexual dysfunctions associated with pelvic pain in men.[38,39]

Finally, pelvic innervation is fundamental to normal male sexual, urinary, and bowel functions. The muscles of the pelvic floor are innervated by sympathetic, parasympathetic, and somatic nerve fibers. The 3 types of nerve fibers allow for careful regulation of pelvic floor muscles, including those responsible for erection, emission, ejaculation, and urinary and fecal continence. The hypogastric, pudendal, and levator ani nerves all participate in these sexual, urinary, and bowel functions. Coordinated contraction of the bulbospongiosus muscle is carried out by input from the pudendal nerve (from spinal nerves S2–4), which is necessary for emission and ejaculation. Emission is mediated through the sympathetic nervous system via the hypogastric nerve innervated by preganglionic neurons in the intermediolateral and medial gray nuclei.[40,41] There is evidence from animal models that contractions of the bulbospongiosus and ischiocavernosus muscles are important for expulsion of seminal fluids and for increased hardness/engorgement of the glans penis.[42] Another study found that contractions of the levator ani in rats act in coordination with the bulbospongiosus muscle to augment penile erectile hardness and that muscle activity is tightly coordinated through somatic innervation during copulation.[43] Given its complexity, it is clear that a comprehensive understanding of pelvic floor anatomy and physiology is crucial to appreciating the intricacies of normal male sexual function.

Erectile Dysfunction and the Male Pelvic Floor

Normal erectile function includes the ability to obtain an erection sufficiently rigid for vaginal penetration and maintain that erection long enough to complete satisfactory sexual intercourse. Penile erection requires the presence of a pressurized and closed hydraulic system within the corpora cavernosa.[44] Erectile dysfunction is said to be present when there is a consistent inability to either obtain and/or maintain that closed system.[45] Estimates of the prevalence of erectile dysfunction range from 9% to 40% of men by age 40, and generally increase by 10% in each decade of life thereafter.[4,46]

The observation that contractions of pelvic floor skeletal muscles, in particular the bulbospongiosus and ischiocavernosus, temporarily increase penile erectile rigidity and hardness is more than a century old. Dorey points out that the 1909 edition of *Gray's Anatomy* published a lithograph labeling the ischiocavernosus as the "erector penis."[47] Contraction of the ischiocavernosus participates in the process of enhancing erectile rigidity by compressing the roots of the corpora cavernosa and inducing short-term suprasystolic intracavernosal pressures.[48,49] Further, bulbospongiosus contraction leads to temporary engorgement of the glans penis and corpus spongiosum and results in similar short-term increases in intraspongiosal pressures.[19,50]

Thus, contraction of both the bulbospongiosus and ischiocavernosus can increase maximal corpora cavernosal and corpus spongiosum rigidity. In some men with erectile dysfunction, such an increase can facilitate achieving and maintaining sufficient erectile hardness during thrusting vaginal penetration. The degree to which these muscles can participate in erection hardness depends on their functional strength and coordination. Indeed, voluntary pelvic floor muscle activation has been shown to be more efficient in men who have full erectile function than in those with erectile dysfunction.[9–11]

Rehabilitation of pelvic floor muscle function has long been suggested as a relevant component of the treatment for erectile dysfunction and has proved to be an effective therapy in selected men.[11,16,49,51–54] Pelvic floor muscle exercise appears to be especially beneficial in men with erectile dysfunction due to mild or moderate veno-occlusive dysfunction.[16,55] Claes et al demonstrated that only a single systolic injection of blood was needed to achieve both tumescence and rigidity in younger, fully potent men.[16] The authors also suggested that in men with erectile dysfunction, voluntary contraction of the ischiocavernosus muscle might provide the necessary increase in intracavernosal pressure to establish or maintain penile hardness sufficient for vaginal penetration.

Abnormally high pelvic floor muscle tone, which consists of pelvic floor muscles that contract more often or more strongly than necessary, or that rest in a state of higher than normal activity, has been suggested as a possible cause of erectile dysfunction. Spasm of the pelvic floor muscles can provide extrinsic compression that restricts the lumen of the internal

pudendal artery and thereby limits internal pudendal arterial inflow.[7,8] This is a potential basis for the high prevalence of erectile dysfunction among individuals with CPPS. Abnormally high pelvic floor muscle tone, especially associated with chronic pain, also may interfere with the physiologic process of corporal veno-occlusive function. Corporal veno-occlusive function is dependent on sustained corporal smooth muscle relaxation.[44] It is hypothesized that high-tone pelvic floor muscles and/or chronic pain is a distraction to effective and sustained corporal smooth muscle relaxation. Reducing high pelvic floor muscle tone and eliminating chronic pain may help facilitate the sustained corporal smooth muscle relaxation needed for development of the closed corporal compartment during erection.

Ejaculatory/Orgasmic Dysfunction and the Male Pelvic Floor

The mechanics of ejaculation reflect a muscular event that occurs via simultaneous contraction of the smooth muscles of the prostate gland, contraction of the smooth muscles of the bladder neck, and relaxation of the smooth muscles of the urethral sphincter. Shafik also demonstrated that rhythmic contractions during ejaculation may act as a "suction—ejection pump," *sucking* the seminal fluid into the posterior urethra while relaxed during emission and *ejecting* it into the bulbous urethra upon contraction during ejaculation.[57] Involuntary contraction of the bulbospongiosus muscle expels contents from the urethra during ejaculation.[19,54] Strong bulbospongiosus muscle contractions may increase maximal engorgement of the corpus spongiosum, increase urethral pressure, and facilitate ejaculation of prostatic and seminal vesicle fluid. Strong bulbospongiosus contractions may also enhance and intensify orgasmic pleasure during ejaculation. Therefore, pelvic floor muscle training may act to optimize ejaculatory volume, force, and intensity of sexual climax.[19]

Premature ejaculation is the most common male sexual dysfunction, negatively affecting the enjoyment of sexual activity for many men and their partners.[2,3] The International Society for Sexual Medicine has defined *premature ejaculation* as a male sexual dysfunction characterized by ejaculation that always or nearly always occurs prior to or within about 1 minute of vaginal penetration; the inability to delay ejaculation on all or nearly all vaginal penetrations; and negative personal consequences, such as distress, bother, frustration, and/or the avoidance of sexual intimacy.[58] In a large multinational survey, the prevalence of premature ejaculation was found to be 23% overall among participants from the United States, Germany, and Italy.[2] Premature ejaculation also negatively impacts male self-image and sexual satisfaction and can adversely affect relationships with their partners.[59]

The importance of pelvic floor muscle function in the treatment of premature ejaculation is only beginning to be appreciated. Pastore suggested that active perineal muscle control could inhibit the ejaculation reflex through intentional relaxation of the bulbospongiosus and ischiocavernosus muscles, but the exact mechanism controlling the ejaculatory reflex remains poorly defined.[12,60]

Several therapies are available to treat premature ejaculation, with some of the most successful being those treatments that have given some attention to the male pelvic floor. Behavioral therapies involve precoital masturbation, increasing sexual activity frequency, and manual or physical maneuvers intended to delay ejaculation. The squeeze technique described by Masters and Johnson makes use of the bulbospongiosus reflex, in which sustained pressure is applied to the glans penis causing contraction of the bulbospongiosus muscle and, as a result, diminished ejaculatory urgency.[61] Stopping the motion of intercourse and performing a sustained contraction of the pelvic floor muscles also can function to defer the urgency of ejaculation, serving as an "internal squeeze" without manual pressure.[19]

Pelvic floor therapy has been shown to improve control over ejaculatory delay and allow significant increases in intravaginal ejaculatory latency times in men with pelvic floor muscle dysfunction.[15,60,62] The application of pelvic floor therapy to the treatment of premature ejaculation is safe and effective, although studies have not yet specifically identified how to appropriately implement muscular strategies. Whether emphasis should be on strength, control, or relaxation is not yet well understood; therefore, current treatment should be tailored to individual findings.

Chronic Prostatitis/Chronic Pelvic Pain Syndrome and the Male Pelvic Floor

Chronic prostatitis/chronic pelvic pain syndrome is characterized by pain in the pelvis, abdomen, or genitals, and lower urinary tract symptoms of an obstructive or irritative nature, without evidence of recurrent urinary tract infection.[18] Prostatitis, in both acute and chronic forms, is a common and often debilitating condition that affects millions of men worldwide. The prevalence of prostatitis varies depending on the population but has been estimated to be as high as 16% in some regions.[63–65] In the late 1990s, the National Institutes of Health (NIH) reclassified prostatitis into distinct categories.[66] Chronic nonbacterial prostatitis was characterized as a chronic pelvic pain syndrome and termed Category III. This entity, CP/CPPS, was further subdivided into 2 subclasses: inflammatory (IIIa) and noninflammatory (IIIb) according to the presence or absence of leukocytes in the expressed prostatic secretions, postprostatic massage urine, and semen.

Discomfort or pain accompanying ejaculation or after ejaculation is common, as are concurrent sexual dysfunctions such as erectile dysfunction and ejaculation/orgasm disorders.[7,63,67,68] Chronic prostatitis/chronic pelvic pain syndrome is strongly associated with both sexual and pelvic floor dysfunction and can significantly impact a man's quality of life and relationships.[69] In one study, men with CP/CPPS had greater rates of depression when compared with controls.[63] Interestingly, their female partners were also adversely affected. Women with male partners with

chronic pelvic pain syndrome reported higher rates of dyspareunia. In another study using the Sickness Impact Profile as a measure of health, Wenninger et al found that men with chronic prostatitis reported scores similar to those with other debilitating illnesses such as myocardial infarction, angina, and Crohn disease.[70]

Sexual dysfunctions associated with CP/CPPS are not uncommon. Prevalence rates of erectile dysfunction in these men have been reported to be as high as 40% in some Asian populations.[7] In a cohort of Finnish men with chronic pelvic pain, the prevalence of erectile dysfunction was similar.[71] Among a group of nearly 300 Malaysian men with male CPPS associated with chronic prostatitis, 72% reported difficulty with either erections or ejaculation.[72] Presence of sexual dysfunction in the Malaysian study also was correlated with greater pelvic symptom severity and worse quality of life. Aubin et al found that American men with CP/CPPS have higher rates of sexual dysfunction, including reports of lower sexual desire, diminished erectile and orgasmic function, and more frequent pain associated with orgasm and/or ejaculation.[67] In that study, erectile function as measured by the Brief Sexual Functioning Questionnaire varied inversely with pain status, independent of other demographic factors.

The apparent correlation between erectile dysfunction and CP/CPPS may be explained by a compromise in penile hemodynamic function. Shoskes et al demonstrated that men with CP/CPPS were more likely to have evidence of arterial stiffness associated with nitric oxide—mediated vascular endothelial dysfunction compared with asymptomatic controls.[73] The authors suggested that this might be related to increased autonomic vascular tone associated with pain-induced chronic stress. In addition, they noted that vascular endothelial dysfunction might contribute to the chronic muscle spasm and pain experienced by men with chronic pelvic pain. Another possible explanation for the high rate of erectile dysfunction among men with chronic pelvic pain is related to the presence of abnormally high resting pelvic floor muscle tone, the incidence of which is high in men who have both sexual dysfunction and sexual pain disorders.[74] Elevated pelvic floor muscle tone is thought to impede normal erectile function by potentially obstructing arterial inflow to the penis via extrinsic muscular compression.[7]

Premature ejaculation also is commonly associated with chronic pelvic pain. In a study, the prevalence of overall sexual dysfunction including premature ejaculation was significantly greater in men with CP/CPPS than in the general population and was negatively correlated with age and duration of the condition.[75] In a Turkish cohort, men with chronic prostatitis were found to have a significantly higher rate of premature ejaculation (77.5%) compared with controls (10%).[76] Another study found a high rate of prostatic inflammation (56.5%) and chronic prostatic infection (47.8%) among a group of men with premature ejaculation.[77] The authors hypothesized that the presence of inflammation or infection within the prostate may alter sensation involved in the ejaculatory reflex and lead to premature ejaculation. Similarly, pelvic floor muscle spasm may impair normal sensory feedback involved in ejaculation and potentially produce the same effect as chronic inflammation.

Ejaculatory pain is another common complaint of men with CP/CPPS. The cause of this association is controversial. In a study of 146 men with CP/CPPS and established pelvic floor muscle spasm, 56% had painful ejaculation.[56] The NIH Chronic Prostatitis Cohort study surveyed 488 men regarding common prostatitis symptoms.[78] A post-hoc data analysis found that 74% of the men surveyed had ejaculatory pain at least intermittently during the first 3 months of the study.[79] In the follow-up study, the participants were stratified into 4 categories according to the frequency of their ejaculatory pain. The negative impact of CP/CPPS on individuals increased with the frequency of their ejaculatory pain, and their mental and physical quality of life decreased. Among the 4 groups, there was no difference in semen bacterial culture or leukocyte count, both markers of inflammation. The authors suggested, based on these findings, that, along with inflammation, neuromuscular spasm represents an important source of ejaculatory pain. Others have shown that men with CP/CPPS have significantly more tenderness, muscle spasm, and dysfunction throughout the abdomen and pelvis.[80–82]

Ejaculatory pain in men with CP/CPPS has been attributed historically to the prostate gland but may also represent myofascial pathology. Visceral and myofascial pain are often both diffuse and poorly localized, and pain generated by either can mimic that of the other. Distinguishing between the 2 can become impossible for the patient, due to convergence of visceral and somatic afferent activity on the same spinal neuron in the dorsal horn. The pain syndrome also can persist long after any initial precipitating event, making clinical diagnosis more challenging.[83] Because CP/CPPS exists at the intersection of the somatic and visceral systems, treatment strategies should aim to decrease afferent activity from both through a multimodal approach.

Pelvic Floor Treatment Strategies in Men With CP/CPPS

Abnormal muscle tone and shortening of the levator ani and external rotators of the hips have been identified as possible culprits in the pathophysiology of CP/CPPS.[20] Indeed, there is significantly more pelvic floor muscle spasm and tension in men with CP/CPPS than in healthy men, with up to 50% showing signs of this musculoskeletal dysfunction.[82] Furthermore, tenderness has been found in these men through palpation of the pelvic floor muscles, psoas, and adductors.[80] In a study by Zermann et al, 88.3% of the patients with CP/CPPS had pathologic tenderness of the pelvic floor muscle and poor to absent pelvic floor muscle function.[84] These authors proposed that because muscle activity reflects neural control, pelvic floor dysfunction associated with pelvic pain might indicate that there is a primary or secondary central nervous system disturbance in regulation of the pelvic floor muscles.

Effective management of CP/CPPS has been demonstrated in programs that emphasize treatment of pelvic floor dysfunction. Tension myalgia associated with abnormally high pelvic floor muscle tone is a significant component of pain and dysfunction in men with CP/CPPS. Therefore, neuromuscular reeducation is an important part of recovery, fostering relaxation of the hypertonic levator ani group.[19–21] Neuromuscular reeducation is the guided conscious retraining of muscle activation and deactivation and coordination of motor strategies in related muscle groups to accomplish a functional task, and is a component of physical therapy treatments across many specializations, including pelvic health. An example of such a functional task relating to the pelvic floor would be relaxation of the puborectalis and external anal sphincter in concert with moderate contraction of the abdominal wall and descent of the respiratory diaphragm to create an increase in intra-abdominal pressure while maintaining an open airway. This coordinated action of muscles facilitates evacuation of the bowels in a way that protects the pelvic floor from undue stress and strain.

With the guidance of electromyography or other methods of biofeedback, neuromuscular reeducation has been shown to result in reduced resting baseline tone of the pelvic floor muscles. This reduction in muscle activity also can produce a reduction in pain ratings, and overall scores on the NIH Chronic Prostatitis Symptom Index (NIH-CPSI), a validated tool useful in assessing quality of life in men with CP/CPPS.[17,21–24]

Various manual therapy techniques are employed by pelvic physical therapists to address painful soft tissue dysfunction, which is commonly found in men with CP/CPPS. These techniques include but are not limited to those known as soft-tissue mobilization, myofascial release, and connective tissue manipulation. Training in manual therapy techniques extends far beyond the scope of entry-level education physical therapist education programs. Physical therapists learn these techniques by way of appropriately credentialed coursework with education formats that consist of hands-on learning and practice. Choice and application of manual soft-tissue techniques in the clinical setting vary among physical therapists and involve assessment of tissue texture, mobility, and the patient's pain, and use of various hand placements and pressures to gradually alter mechanical properties of soft tissue, as well as activity in the peripheral and central nervous system. Manual therapy to release painful myofascial trigger points in the pelvic floor, combined with paradoxical relaxation training involving relaxation of the pelvic floor muscles by first performing a volitional contraction, has been shown to improve symptoms of pelvic pain, lower urinary tract symptoms, and sexual dysfunction in men.[56] More extensive pelvic floor muscle training also can be beneficial in this group of men, as it functions to instill awareness of a more relaxed state of these muscles, as one cycles through repetitions of contraction and relaxation.[19] However, care must be taken not to aggravate pain of already tense and tender muscles as a result of performing voluntary contractions. When exercised properly, this approach has been used successfully by pelvic floor physical therapists in the clinical setting and has been effective in reducing either pain or overall NIH-CPSI scores.[23]

CONCLUSION

In summary, the role of the pelvic floor in male sexual dysfunction and the importance of pelvic floor physical therapy are only beginning to be appreciated by the sexual medicine community. Treatment of the pelvic floor has been shown to result in significant functional improvement of sexual health in selected men with concomitant pelvic floor and sexual dysfunction, especially in the presence of CP/CPPS. Additional research is needed to better understand the anatomy and physiological function of the male pelvic floor and to identify which men with sexual dysfunction will benefit from pelvic floor rehabilitation, an important part of a more comprehensive, multidisciplinary bio-neuromusculoskeletal-psychosocial model.

Corresponding Author: Deborah Cohen, PT, MS, CSCS, COMT, WCS, Fundamental Physical Therapy & Pelvic Wellness, 5555 Reservoir Drive, Suite 300, San Diego, CA 92120, USA. Tel: (619) 265-8865; Fax: (619) 265-7696; E-mail: debbiecohen@gmail.com

Funding: None.

Conflict of interest: The authors report no conflicts of interest.

STATEMENT OF AUTHORSHIP

Category 1

(a) **Conception and Design**
Deborah Cohen, PT, MS, CSCS, COMT, WCS; Joshua Gonzalez, MD; Irwin Goldstein, MD

(b) **Acquisition of Data**
Deborah Cohen; Joshua Gonzalez; Irwin Goldstein

(c) **Analysis and Interpretation of Data**
Deborah Cohen; Joshua Gonzalez; Irwin Goldstein

Category 2

(a) **Drafting the Article**
Deborah Cohen; Joshua Gonzalez; Irwin Goldstein

(b) **Revising It for Intellectual Content**
Deborah Cohen; Joshua Gonzalez; Irwin Goldstein

Category 3

(a) **Final Approval of the Completed Article**
Deborah Cohen; Joshua Gonzalez; Irwin Goldstein

REFERENCES

1. Bø K. Pelvic floor muscle training in treatment of female stress urinary incontinence, pelvic organ prolapse and sexual dysfunction. World J Urol 2012; 30:437.
2. Porst H, Montorsi F, Rosen RC, Gaynor L, Grupe S, Alexander J. The Premature Ejaculation Prevalence and Attitudes (PEPA)

survey: prevalence, comorbidities, and professional help-seeking. **Eur Urol 2007; 51:816; discussion 824.**

3. Althof SE. Prevalence, characteristics and implications of premature ejaculation/rapid ejaculation. **J Urol 2006; 175(3 Pt 1):842.**
4. Feldman HA, Goldstein I, Hatzichristou DG, Krane RJ, McKinlay JB. Impotence and its medical and psychosocial correlates: results of the Massachusetts Male Aging Study. **J Urol 1994; 151:54.**
5. Lin YH, Yu TJ, Lin VC, Wang HP, Lu K. Effects of early pelvic-floor muscle exercise for sexual dysfunction in radical prostatectomy recipients. **Cancer Nurs 2012; 35:106.**
6. Messelink B, Benson T, Berghmans B, et al. Standardization of terminology of pelvic floor muscle function and dysfunction: report from the Pelvic Floor Clinical Assessment Group of the International Continence Society. **Neurourol Urodyn 2005; 24:374.**
7. Tran CN, Shoskes DA. Sexual dysfunction in chronic prostatitis/chronic pelvic pain syndrome. **World J Urol 2013; 31:741.**
8. Shoskes DA. The challenge of erectile dysfunction in the man with chronic prostatitis/chronic pelvic pain syndrome. **Curr Urol Rep 2012; 13:263.**
9. Kawanishi Y, Kishimoto T, Kimura K, et al. Spring balance evaluation of the ischiocavernosus muscle. **Int J Impot Res 2001; 13:294.**
10. Colpi GM, Negri L, Nappi RE, Chinea B. Perineal floor efficiency in sexually potent and impotent men. **Int J Impot Res 1999; 11:153.**
11. Dorey G. Conservative treatment of erectile dysfunction. 3: Literature review. **Br J Nurs 2000; 9:859.**
12. Rosenbaum TY. Pelvic floor involvement in male and female sexual dysfunction and the role of pelvic floor rehabilitation in treatment: a literature review. **J Sex Med 2007; 4:4.**
13. Shafik A. Pudendal canal decompression in the treatment of erectile dysfunction. **Arch Androl 1994; 32:141.**
14. Shafik A. Pudendal artery syndrome with erectile dysfunction: treatment by pudendal canal decompression. **Arch Androl 1995; 34:83.**
15. La Pera G, Nicastro A. A new treatment for premature ejaculation: the rehabilitation of the pelvic floor. **J Sex Marital Ther 1996; 22:22.**
16. Claes H, Baert L. Pelvic floor exercise versus surgery in the treatment of impotence. **Br J Urol 1993; 71:52.**
17. Litwin MS, McNaughton-Collins M, Fowler FJ, et al. The National Institutes of Health chronic prostatitis symptom index: development and validation of a new outcome measure. Chronic Prostatitis Collaborative Research Network. **J Urol 1999; 162:369.**
18. Schaeffer AJ, Datta NS, Fowler JE, et al. Overview summary statement. Diagnosis and management of chronic prostatitis/chronic pelvic pain syndrome (CP/CPPS). **Urology 2002; 60(6 Suppl):1.**
19. Siegel AL. Pelvic floor muscle training in males: practical applications. **Urology 2014; 84:1.**
20. Segura JW, Opitz JL, Greene LF. Prostatosis, prostatitis or pelvic floor tension myalgia? **J Urol 1979; 122:168.**
21. Cornel EB, van Haarst EP, Schaarsberg RW, Geels J. The effect of biofeedback physical therapy in men with chronic pelvic pain syndrome type III. **Eur Urol 2005; 47:607.**
22. Clemens JQ, Nadler RB, Schaeffer AJ, Belani J, Albaugh J, Bushman W. Biofeedback, pelvic floor re-education, and bladder training for male chronic pelvic pain syndrome. **Urology 2000; 56:951.**
23. Nadler RB. Bladder training biofeedback and pelvic floor myalgia. **Urology 2002; 60(6 Suppl):42; discussion 44.**
24. Duclos AJ, Lee CT, Shoskes DA. Current treatment options in the management of chronic prostatitis. **Ther Clin Risk Manag 2007; 3:507.**
25. Raizada V, Mittal RK. Pelvic floor anatomy and applied physiology. **Gastroenterol Clin North Am 2008; 37:493, vii.**
26. Bharucha AE. Pelvic floor: anatomy and function. **Neurogastroenterol Motil 2006; 18:507.**
27. Pischedda A, Fusco F, Curreli A, Grimaldi G, Pirozzi Farina F. Pelvic floor and sexual male dysfunction. **Arch Ital Urol Androl 2013; 85:1.**
28. Drake RL, Vogl AW, Mitchell AWM. Gray's Anatomy for Students. 2nd ed. London: Elsevier; 2009.
29. Juárez R, Cruz Y. Urinary and ejaculatory dysfunction induced by denervation of specific striated muscles anatomically related to the urethra in male rats. **Neurourol Urodyn 2014; 33:437.**
30. Dorey G. Are erectile and ejaculatory dysfunction associated with postmicturition dribble? **Urol Nurs 2003; 23:42, 48–52.**
31. DeLancey J. Functional Anatomy of the Female Pelvis. 1st ed. Philadelphia: Lippincott; 1994.
32. Stoker J. Anorectal and pelvic floor anatomy. **Best Pract Res Clin Gastroenterol 2009; 23:463.**
33. Percy JP, Neill ME, Swash M, Parks AG. Electrophysiological study of motor nerve supply of pelvic floor. **Lancet 1981; 1:16.**
34. Yoo S, Dedova I, Pather N. An appraisal of the short lateral rotators of the hip joint. **Clin Anat 2015; 28:800.**
35. Hodges PW, McLean L, Hodder J. Insight into the function of the obturator internus muscle in humans: observations with development and validation of an electromyography recording technique. **J Electromyogr Kinesiol 2014; 24:489.**
36. Aung HH, Sakamoto H, Akita K, Sato T. Anatomical study of the obturator internus, gemelli and quadratus femoris muscles with special reference to their innervation. **Anat Rec 2001; 263:41.**
37. Insola A, Granata G, Padua L. Alcock canal syndrome due to obturator internus muscle fibrosis. **Muscle Nerve 2010; 42:431.**
38. Filler AG. Diagnosis and treatment of pudendal nerve entrapment syndrome subtypes: imaging, injections, and minimal access surgery. **Neurosurg Focus 2009; 26:E9.**
39. Popeney C, Ansell V, Renney K. Pudendal entrapment as an etiology of chronic perineal pain: diagnosis and treatment. **Neurourol Urodyn 2007; 26:820.**

40. Nadelhaft I, Booth AM. The location and morphology of preganglionic neurons and the distribution of visceral afferents from the rat pelvic nerve: a horseradish peroxidase study. **J Comp Neurol 1984; 226:238.**
41. Giuliano F. Neurophysiology of erection and ejaculation. **J Sex Med 2011; 4(8 Suppl):310.**
42. Dobberfuhl AD, Oti T, Sakamoto H, Marson L. Identification of CNS neurons innervating the levator ani and ventral bulbospongiosus muscles in male rats. **J Sex Med 2014; 11:664.**
43. Holmes GM, Sachs BD. Physiology and mechanics of rat levator ani muscle: evidence for a sexual function. **Physiol Behav 1994; 55:255.**
44. Andersson KE, Wagner G. Physiology of penile erection. **Physiol Rev 1995; 75:191.**
45. NIH Consensus Conference. Impotence. NIH Consensus Development Panel on Impotence. **JAMA 1993; 270:83.**
46. Nicolosi A, Moreira ED, Shirai M, Bin Mohd Tambi MI, Glasser DB. Epidemiology of erectile dysfunction in four countries: cross-national study of the prevalence and correlates of erectile dysfunction. **Urology 2003; 61:201.**
47. Dorey G. Pelvic Dysfunction in Men: Diagnosis and Treatment of Male Incontinence and Erectile Dysfunction. 1st ed. Chichester, UK: Wiley; 2006.
48. Lavoisier P, Courtois F, Barres D, Blanchard M. Correlation between intracavernous pressure and contraction of the ischiocavernosus muscle in man. **J Urol 1986; 136:936.**
49. Lavoisier P, Roy P, Dantony E, Watrelot A, Ruggeri J, Dumoulin S. Pelvic-floor muscle rehabilitation in erectile dysfunction and premature ejaculation. **Phys Ther 2014; 94:1731.**
50. Wespes E, Nogueira MC, Herbaut AG, Caufriez M, Schulman CC. Role of the bulbocavernosus muscles on the mechanism of human erection. **Eur Urol 1990; 18:45.**
51. Claes H, van Hove J, van de Voorde W, et al. Pelvi-perineal rehabilitation for dysfunctioning erections. A clinical and anatomo-physiologic study. **Int J Impot Res 1993; 5:13.**
52. Schouman M, Lacroix P. [Role of pelvi-perineal rehabilitation in the treatment of cavernous venous leakage]. **Ann Urol (Paris) 1991; 25:93.**
53. Dorey G, Speakman M, Feneley R, Swinkels A, Dunn C, Ewings P. Randomised controlled trial of pelvic floor muscle exercises and manometric biofeedback for erectile dysfunction. **Br J Gen Pract 2004; 54:819.**
54. Dorey G, Speakman MJ, Feneley RC, Swinkels A, Dunn CD. Pelvic floor exercises for erectile dysfunction. **BJU Int 2005; 96:595.**
55. Van Kampen M, De Weerdt W, Claes H, Feys H, De Maeyer M, Van Poppel H. Treatment of erectile dysfunction by perineal exercise, electromyographic biofeedback, and electrical stimulation. **Phys Ther 2003; 83:536.**
56. Anderson RU, Wise D, Sawyer T, Chan CA. Sexual dysfunction in men with chronic prostatitis/chronic pelvic pain syndrome: improvement after trigger point release and paradoxical relaxation training. **J Urol 2006; 176(4 Pt 1):1534; discussion 1538.**
57. Shafik A. The role of the levator ani muscle in evacuation, sexual performance and pelvic floor disorders. **Int Urogynecol J Pelvic Floor Dysfunct 2000; 11:361.**
58. McMahon CG, Althof SE, Waldinger MD, et al. An evidence-based definition of lifelong premature ejaculation: report of the International Society for Sexual Medicine (ISSM) Ad Hoc Committee for the Definition of Premature Ejaculation. **J Sex Med 2008; 5:1590.**
59. Symonds T, Roblin D, Hart K, Althof S. How does premature ejaculation impact a man s life? **J Sex Marital Ther 2003; 29:361.**
60. Pastore AL, Palleschi G, Leto A, et al. A prospective randomized study to compare pelvic floor rehabilitation and dapoxetine for treatment of lifelong premature ejaculation. **Int J Androl 2012; 35:528.**
61. Masters W, Johnson V. Human sexual inadequacy. London: Churchill; 1970.
62. Piediferro G, Colpi EM, Castiglioni F, Scroppo FI. Premature ejaculation. 3. **Therapy. Arch Ital Urol Androl 2004; 76:192.**
63. Smith KB, Pukall CF, Tripp DA, Nickel JC. Sexual and relationship functioning in men with chronic prostatitis/chronic pelvic pain syndrome and their partners. **Arch Sex Behav 2007; 36:301.**
64. Krieger JN, Riley DE, Cheah PY, Liong ML, Yuen KH. Epidemiology of prostatitis: new evidence for a world-wide problem. **World J Urol 2003; 21:70.**
65. Roberts RO, Jacobson DJ, Girman CJ, Rhodes T, Lieber MM, Jacobsen SJ. Prevalence of prostatitis-like symptoms in a community based cohort of older men. **J Urol 2002; 168:2467.**
66. Krieger JN, Nyberg L, Nickel JC. NIH consensus definition and classification of prostatitis. **JAMA 1999; 282:236.**
67. Aubin S, Berger RE, Heiman JR, Ciol MA. The association between sexual function, pain, and psychological adaptation of men diagnosed with chronic pelvic pain syndrome type III. **J Sex Med 2008; 5:657.**
68. Tan JK, Png DJ, Liew LC, Li MK, Wong ML. Prevalence of prostatitis-like symptoms in Singapore: a population-based study. **Singapore Med J 2002; 43:189.**
69. McNaughton Collins M, Pontari MA, O'Leary MP, et al. Quality of life is impaired in men with chronic prostatitis: the Chronic Prostatitis Collaborative Research Network. **J Gen Intern Med 2001; 16:656.**
70. Wenninger K, Heiman JR, Rothman I, Berghuis JP, Berger RE. Sickness impact of chronic nonbacterial prostatitis and its correlates. **J Urol 1996; 155:965.**
71. Mehik A, Hellström P, Sarpola A, Lukkarinen O, Järvelin MR. Fears, sexual disturbances and personality features in men with prostatitis: a population-based cross-sectional study in Finland. **BJU Int 2001; 88:35.**
72. Lee SW, Liong ML, Yuen KH, et al. Adverse impact of sexual dysfunction in chronic prostatitis/chronic pelvic pain syndrome. **Urology 2008; 71:79.**
73. Shoskes DA, Prots D, Karns J, Horhn J, Shoskes AC. Greater endothelial dysfunction and arterial stiffness in men with

chronic prostatitis/chronic pelvic pain syndrome—a possible link to cardiovascular disease. **J Urol 2011; 186:907.**

74. Rosenbaum TY, Owens A. The role of pelvic floor physical therapy in the treatment of pelvic and genital pain-related sexual dysfunction (CME). **J Sex Med 2008; 5:513; quiz 524.**
75. Liang CZ, Zhang XJ, Hao ZY, Shi HQ, Wang KX. Prevalence of sexual dysfunction in Chinese men with chronic prostatitis. **BJU Int 2004; 93:568.**
76. Gonen M, Kalkan M, Cenker A, Ozkardes H. Prevalence of premature ejaculation in Turkish men with chronic pelvic pain syndrome. **J Androl 2005; 26:601.**
77. Screponi E, Carosa E, Di Stasi SM, Pepe M, Carruba G, Jannini EA. Prevalence of chronic prostatitis in men with premature ejaculation. **Urology 2001; 58:198.**
78. Schaeffer AJ, Landis JR, Knauss JS, et al. Demographic and clinical characteristics of men with chronic prostatitis: the National Institutes of Health chronic prostatitis cohort study. **J Urol 2002; 168:593.**
79. Shoskes DA, Landis JR, Wang Y, et al. Impact of post-ejaculatory pain in men with category III chronic prostatitis/chronic pelvic pain syndrome. **J Urol 2004; 172:542.**
80. Hetrick DC, Ciol MA, Rothman I, Turner JA, Frest M, Berger RE. Musculoskeletal dysfunction in men with chronic pelvic pain syndrome type III: a case-control study. **J Urol 2003; 170:828.**
81. Berger RE, Ciol MA, Rothman I, Turner JA. Pelvic tenderness is not limited to the prostate in chronic prostatitis/chronic pelvic pain syndrome (CPPS) type IIIA and IIIB: comparison of men with and without CP/CPPS. **BMC Urol 2007; 7:17.**
82. Shoskes DA, Berger R, Elmi A, et al. Muscle tenderness in men with chronic prostatitis/chronic pelvic pain syndrome: the chronic prostatitis cohort study. **J Urol 2008; 179:556.**
83. Doggweiler-Wiygul R. Urologic myofascial pain syndromes. **Curr Pain Headache Rep 2004; 8:445.**
84. Zermann DH, Ishigooka M, Doggweiler R, Schmidt RA. Neurourological insights into the etiology of genitourinary pain in men. **J Urol 1999; 161:903.**