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DIAGNOSTIC METHODS: Original Research

A comprehensive physical therapy evaluation for Male Chronic Pelvic Pain Syndrome: A case series exploring common findings

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A R T I C L E I N F O

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A B S T R A C T

Introduction: Male Chronic Pelvic Pain Syndrome (MCPPS) is a complex condition and difficult to decipher due to the multifactorial etiologies and system interrelationships. No studies to date have described a movement-based, multisystem assessment including the musculoskeletal, visceral, nervous, lymphatic and vascular systems, as well as manual prostate mobility testing.
The purpose of this paper is to demonstrate the importance of a comprehensive physical therapy evaluation to identify predominant mechanical and movement-based dysfunctions related to multiple anatomical structures and their interrelationships. Furthermore, symptoms and potentially confounding psychosocial, and environmental factors linked to MCPPS will be presented, and an overview of prospective treatment will be provided.
Method: A retrospective analysis of evaluative findings for ten men was performed. The men, with an average age 35 (range 24–46) were referred to physical therapy for MCPPS.
Results: This retrospective analysis of ten patients identifies potential contributing pain factors associated with MCPPS. Similarities in clinical presentation among men suffering from MCPPS were identified to include predominant mechanical dysfunctions of the thoraco-lumbar spine, the liver, the kidney, the femoral nerve, the bladder, the prostate, and the pelvic floor.
Conclusion: The observations in this retrospective study demonstrate that the use of a multisystem assessment approach in patients with MCPPS is critical for their more effective treatment. On the basis of these findings, and the close mechanical interrelationships of the anatomical elements involved and multisystem MCPPS etiologies, larger-scale research is warranted.

1. Introduction

Male Chronic Pelvic Pain Syndrome (MCPPS) is defined as pain, pressure, or discomfort localized in the pelvic region, perineum, or genitalia lasting more than 3 months, in the absence of uropathogenic bacteria. This complex condition is difficult to decipher due to the multi-factorial etiologies and system interrelationships. The UPOINT system is an internationally validated classification system used clinically by physicians and urologists to identify domains and clinical findings related to male chronic pelvic pain (see Table 1) (Nickel et al., 2010). This classification system comprises six domains, assessing the urinary system (voiding and storage), the psychosocial state (depression and catastrophizing), specific organs (bladder and prostate other than infection), infectious disease process (urine and expressed prostatic secretions), the neurological system (focal and systemic), and tenderness of pelvic floor skeletal muscles (Nickel et al., 2010).

Recent reports show that more than 20% of patients are categorized in multiple domains. This indicates that in many cases more than one system is involved. However, physical therapy treatment is principally recommended for the domain associated with tenderness of pelvic floor skeletal muscles, which limits rehabilitation of patients categorized in other domains (Nickel et al., 2010). This may stem from existing literature in which only the assessment of physical characteristics pertaining principally to the musculoskeletal system has been systematically described and studied; tenderness, hypertonicity, and dyssynergia of the levator

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Table 1
Clinical descriptions of the six UPOINT domains (Nickel et al., 2010).

U Urinary	* CPI urinary score >4 * Patient complaint of bothersome urgency, frequency, or nocturia * Flow rate <15 mL/s and/or obstructed pattern * Postvoid residual urine volume >100 ml
P Psychosocial	* Clinical depression * Poor coping or maladaptive behavior, e.g. evidence of catastrophizing (magnification or rumination in regard to symptoms, hopelessness) or poor social interaction
O Organ Specific	* Specific prostate tenderness * Leukocytosis in prostatic fluid * Haematospermia * Extensive prostatic calcification
I Infection	* Exclude patients with clinical evidence of acute (acute infection) or chronic bacterial prostatitis recurrent infection that is localized to prostate specimen between infections) * Gram-negative bacilli or enterococcus localized to prostatic fluid * Documented successful response to antimicrobial therapy
N Neurological/Systemic conditions	* Pain beyond abdomen and pelvis * Irritable bowel syndrome * Fibromyalgia * Chronic fatigue syndrome
T Tenderness of skeletal muscles	* Palpable tenderness and/or painful muscle spasm or trigger points in perineum or pelvic floor or sidewalls during DRE examination

ani and pelvic muscles have been the major clinical findings reported (FitzGerald et al., 2013; Pontari, 2008; Hetrick, 2003). Dyssynergia is defined as a paradoxical contraction or the inability to relax the pelvic floor muscles during straining or bearing down. Current review of literature defines MCPPS as a psychoneuromuscular disorder and reemphasizes the importance of physical therapy in treating the musculoskeletal system. Positive outcomes are reported using modalities such as myofascial trigger point release in combination with cognitive behavioral therapy (Anderson et al., 2018).

From an evidence-based approach, manual examination not only encompasses the assessment of the musculoskeletal system, but also the visceral and neural systems (Michallet, 1986; Nemett et al., 2008; Villafañe et al., 2012; Zollars et al., 2019). Thoracolumbar disc dysfunction has been described as referring pain into the testicular region, suggesting a mechanical relationship between anatomical structures (Doubleday et al., 2003). Literature also reports on the positive effect of visceral mobility and treatment. McSweeney et al. demonstrated the effect of sigmoid manipulation on pressure pain threshold in the lumbar spine (McSweeney et al, 2012). Interestingly, Michallet studied with ultrasound imaging the effect of kidney mobility on twenty-five patients suffering from thoracolumbar pain, cystitis, sciatica, and knee pain, before manipulation, after manipulation, and two to four months following the manipulation. Increased kidney mobility was noted in twenty-three participants and significant decrease in symptoms were reported. He also indicated that sixteen out of the eighteen retested participants showed additional increase in renal mobility between two and six months post manipulation, suggesting a possible delayed response and body adaptation to the visceral manipulation (Michallet, 1986). It is noted that the referral pain originating from visceral motility and mobility restriction is less understood. Visceral motility is defined as the inner movement of an organ within its axis and is believed to stem from embryological development (Barral et al., 1988). Manual examination and treatment of neural tissue have shown promising outcomes in addressing musculoskeletal conditions Villafañe et al. concluded that radial mobilization decreases pain sensitivity and improves motor performance in patients with thumb carpometacarpal osteoarthritis in a randomized controlled trial (Villafañe et al., 2012). Zollars et al. demonstrated the benefit of visceral and neural manipulation in the treatment of chronic constipation in children with cerebral palsy (Zollars et al., 2019). Archambault-Ezenwa et al. described the assessment of the pudendal nerve in a female patient suffering from constipation (Archambault-Ezenwa et al., 2016). Thus far, the focus has been in substantiating the effectiveness of innovative treatment modalities without extensive emphasis on a multisystem assessment specifically adapted to MCPPS population. Finally, some literature has identified a relationship between the abdominal and pelvic lymphatic and vascular systems (Solan et al., 2013; Swanson et al., 2013). Anatomically, the superior hemorrhoidal vein of the rectum drains into the inferior mesenteric vein, ultimately reaching the portal system within the liver; and the middle rectal vein drains into the internal iliac, emptying into the inferior vena cava (Solan et al., 2013; Swanson et al., 2013). Restriction along the pathway of the venous, arterial, and lymphatic system may impede adequate irrigation and drainage to and from the abdominal and pelvic organs found in MCPPS patients (Dellabella et al., 2006; Wasserman, 1999).

Diagnostic imaging of the pelvis including ultrasound, computed tomography scan (CT scan), and magnetic resonance imaging (MRI) can be useful in identifying structural changes associated with MCPPS/prostatitis and/or identifying differential diagnosis associated with pelvic pain, such as cancer (Nickel et al., 2010). A series of physiological changes that may contribute to the pain associated with MCPPS as seen on transrectal ultrasound include; hypoechoic zones, calcification, venous congestion, and increased arterial flow (Dellabella et al., 2006; Wasserman, 1999). Brain neuromodulation was also recorded by functional magnetic resonance imaging (Farmer et al., 2011). Specific patterns of brain activation and brain anatomical reorganization were found in men with MCPPS compared to normal subjects (Farmer et al., 2011). The central neurological changes associated with MCPPS contributing to central sensitization and the maintenance of the never-ending pain cycle has been suggested in some literature (Farmer et al., 2011; Pontari, 2008). Diagnostic imaging is an additional assessment component corroborating the dysfunction of the multiple systems impacted with MCPPS.

Sexual dysfunction, anxiety, and depression have been identified as comorbidities to MCPPS (Tran et al., 2013; Pontari, 2008). Tran et al. reported an array of prevalent sexual dysfunctions in men suffering from chronic pelvic pain, including erectile dysfunction, painful ejaculation, and premature ejaculation, suggesting a multifactorial association with vascular, neuromuscular, endocrine, and psychologic etiologies (Tran et al., 2013). Validated questionnaires including the Pain Catastrophizing and the Depression Anxiety Stress Scales can be used to assess the psychological impact associated with MCPPS (Nickel et al., 2010). Behavior and lifestyle may contribute to certain pain triggers. Herati et al. reported that patients with MCPPS appear to be more susceptible to certain food, beverage, and dietary supplements (Herati et al., 2013). An in-depth medical intake questionnaire and validated questionnaires, including the NIH-Chronic prostatitis symptom index, to assess symptoms, behavior, and pre-existing conditions is important due to the multifactorial nature of this syndrome and can aid in identifying correlations amongst men with MCPPS.

Although research has shown the interplay of a multisystem involvement, thus far, no studies to date have delineated a movement-based, multisystem assessment including the musculoskeletal, visceral, nervous, lymphatic and vascular systems, as well as manual prostate mobility testing. Clear identification of the primary mechanical dysfunctions of anatomical structures associated with MCPPS at a multisystem level to create the best treatment plan and projected outcome within the multiple domains of the UPOINT system is yet to be presented.

The purpose of this paper is to demonstrate the importance of a comprehensive physical therapy evaluation to identify predominant mechanical and movement-based dysfunctions related to multiple anatomical structures and their interrelationships. Furthermore, symptoms and potentially confounding psychosocial and environmental factors linked to MCPPS will be presented, and an overview of prospective treatment will be provided.

2. Method

A retrospective analysis of evaluative findings for ten men with MCCPS was performed. The selected criteria for inclusion limited our study to a sample of ten participants: selection of patients at a single clinical location, pain level of at least 3/10, a diagnosis related to MCPPS, patients who had undergone biofeedback treatment, and a minimal length of treatment of three sessions. Procedures were conducted according to the declaration of Helsinki and informed consent was obtained from the patients. The protocol was approved by the Barral Osteopathic Teaching Organization.

Ten men, with an average age of 35 (range 24–46), were referred to physical therapy for MCPPS from their primary care physician, urologist, and/or colorectal surgeon. Specific referral diagnoses displayed in Fig. 1 are prostatitis, testicular pain, chronic pelvic pain, pudendal neuralgia, and levator ani spasm.

The average time between the onset of pain and symptoms and the initial physical therapy evaluation was 33 months (range 2 months–9 years). All selected men reported a pain level graded 3/10 or higher, on the modified analog pain scale. Only one man had his prostate removed nineteen months prior to the beginning of treatment. However, he disclosed history of acute prostatitis a few years prior to his surgery. An average of 7.6 visits was provided (range 3 visits to 21 visits), incorporating a comprehensive treatment approach which included prostate and nerve manipulation, visceral manipulation, exercises, pelvic muscle reeducation/biofeedback, behavioral modifications, trigger points and myofascial release, neuromuscular reeducation, craniosacral therapy and visceral vascular manipulation.

A complete medical history, including functional limitations, and pain levels using the modified analog pain scale associated with sexual, bladder, and bowel function, as well as functional activities was collected (see appendix 1).

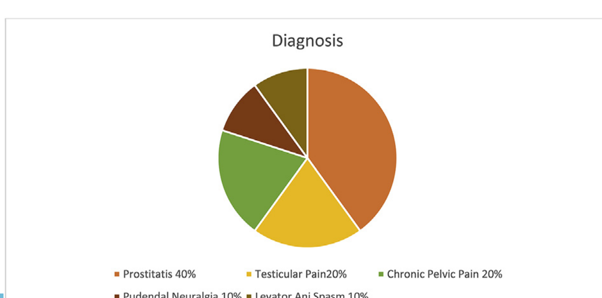

Fig. 1. Percentage of specific diagnoses referred to physical therapy.

2.1. Physical therapy assessment

2.1.1. Musculoskeletal

A lower quadrant musculoskeletal assessment was carried out to include neurological examination, lower extremity range of motion, and muscle strength testing (Archambault-Ezenwa et al., 2016). The spinal symmetry and mobility were assessed to identify possible dysfunction, hypomobility, and pain reproduction. Specific attention was paid to the lumbosacral as well as the thoracolumbar junctions, because of possible referral pain patterns to the perineum. The sacro-iliac and spine symmetry was evaluated for both static and dynamic alignment and to identify hypomobility segments and/or reproduction of pain. The sacro-iliac joint was assessed with compression and gapping testing, Patrick's, Gaelan's, and the posterior pelvic pain provocation test (thigh thrust) (Hamidi-Ravari et al., 2014; Van Der Wurff et al., 2000). Mobility of the ribs was examined to identify hypomobility and pain.

Palpation was used to evaluate muscle tone, pain, and spasm. The iliopsoas, the recti abdominus, the quadratus lumborum, the gluteal/piriformis, the hip adductors, the obturator internus and the levator ani muscles were assessed. Transrectal biofeedback evaluated pelvic floor muscle function including strength, tone, and coordination.

2.1.2. Visceral manipulation

Abdominal and pelvic organ motility and mobility were manually assessed. Organ mobility is executed through manual multiplanar movements (McSweeney et al., 2012; Barral et al., 1988; Michallet, 1986). The liver is assessed in a forward bend sitting position. The therapist stands behind the client, and positions their hands underneath the rib cage, gently pressing the finger pads antero-posteriorly, then superiorly (Barral et al., 1988). Fascial restriction in relation to the neighboring organs is tested. Kidney mobility is also tested in a similar fashion with manual contact through the inferior pole bilaterally (Michallet, 1986). Bladder mobility testing is conducted supine by placing the index and thumb finger pads on each side of the bladder cephalad to the pubic symphysis and is mobilized in all planes. The inguinal canal is assessed at the base of the penis above the inguinal ligament bilaterally to rule-out restrictions and/or inguinal hernias (Barral, 2010). The genitofemoral, iliohypogastric, and ilioinguinal (T12-L3) nerves cross through the canal and provide important innervation to the perineum, testicles, and lower extremities.

The prostate is assessed transrectally in a prone position (Barral, 2010). However, the hook-lying position provides a good alternative to test the mobility of the bladder and the prostate simultaneously (see Fig. 2).

The size of the prostate in younger males is approximately 3 cm vertically, 4 cm horizontally, and 2.5 cm in width. The prostate is comprised of a glandular (66%) and a muscular (33%) portion and should be firm and smooth with a middle groove separating the right and left lobe. The absence of the groove may be a sign of hypertrophy. Induration and an irregular circumscribed zone may be a sign of cancer which would warrant a referral to the urologist for further evaluation. A boggy prostate and sensitivity upon palpation can also be frequent findings particularly in cases of prostatitis. Prostate elasticity, mobility, and compressibility is assessed in a multiplanar fashion, in relationship to the surrounding organs and the fascial system (see Table 2) (Barral, 2010; Raychaudhuri et al., 2008).

2.1.3. Neural manipulation

Neural manipulation assessment determines nerve mobility, elasticity and compressibility (Villafañe et al., 2012; Barral, 2007). The femoral nerve, located inferior to the inguinal ligament and

Fig. 2. Prostate mobility testing in a hook-lying position. The external hand anchors the bladder and the intrarectal index finger rests on the cranial prostate while applying a gentle caudal traction.

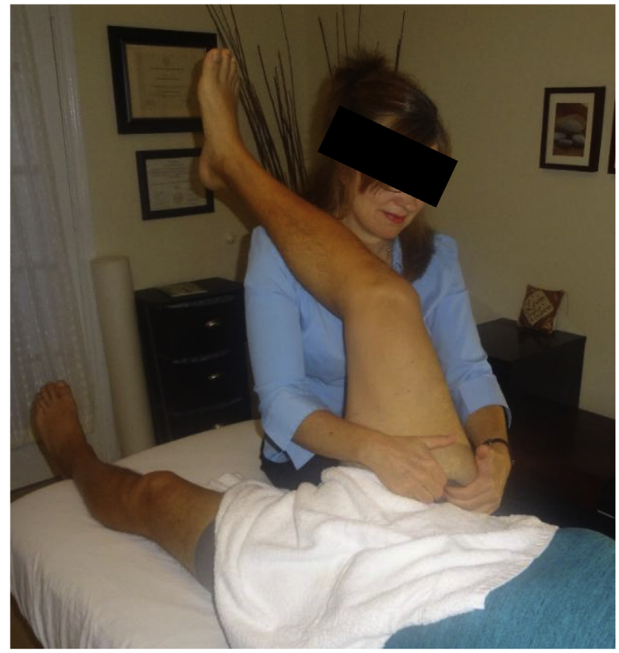

Fig. 3. Femoral nerve manipulation. The finger pads of bilateral hands are placed below the inguinal ligament and lateral to the arterial pulse, and a gentle inferior traction is applied to the nerve. Nerve mobility is assessed inferiorly, superiorly, medially, and laterally with the hip positioned in a slight flexion.

lateral to the femoral artery, is assessed by gently gliding the nerve laterally, medially, superiorly, and inferiorly (see Fig. 3) (Anloague et al., 2009; Barral, 2007).

The sciatic nerve is assessed in a side-lying position. The finger pads are positioned inferior to the piriformis and lateral to the pudendal nerve. Nerve gliding is then performed in all directions. The pudendal nerve can be accessed externally lateral to the sacrum and inferior to the piriformis, as well as internally inferior to the ischial spine and as it exits the Alcock's canal (Archambault-Ezenwa et al., 2016). Connection of the pudendal nerve can also be made by engaging the external hand with the intrarectal finger to feel for pain, entrapment, and decreased mobility.

2.1.4. External and intrarectal perineum assessment

The external perineal assessment includes observation of the external perineum and neurological testing. The intrarectal assessment will provide information in regard to mobility, pain, and function relating to the musculoskeletal, visceral, neural, vascular, and lymphatic system. The assessment is conducted in a prone position (Barral, 2010). Consent to undergo intrarectal assessment is always obtained from the patients. The external perineum receives integumentary inspection for coloration, anal irritation, pelvic floor contraction, external hemorrhoids, fissure, and anal wink and cough reflex in order to rule out pudendal nerve involvement (Archambault-Ezenwa et al., 2016). The therapist's lubricated finger is inserted slowly, while the patient bears down for ease of insertion. The patient is asked to contract the pelvic floor, hold the contraction for 10 s, and quick contractions performed over a 10 s period are also measured (Laycock and Jerwood, 2001). The patient is then asked to bear down simulating defecation mechanics, to assess for dyssynergic patterns (Archambault-Ezenwa et al., 2016). A simultaneous abdominal contraction and a pelvic floor muscle and external anal sphincter relaxation should be palpated and observed. The lymphatic drainage is assessed rectally. The lymphatic flow caudal to the pectinate line drains inferiorly ultimately reaching the inguinal nodes. The distal 1/3 of the rectum,

Table 2
Prostate mobility assessment prone (Barral, 2010; Raychaudhuri et al., 2008).

Prostate Mobility	Finger Position on the Prostate	Direction of Movement	Structure Fixation Assessed	Positive Findings
Posterior	Cranial	Cephalad and Anterior Caudal and Anterior	Fixation of prostatoperitoneal aponeurosis of Denonvillier, vesico-prostatic fascia, seminal vesicle Fixation between urethra and prostate, bladder neck	↓ mobility Crepitation Sensitivity
Compression	Cranial to caudal	Posterior to anterior towards pubis	Fixation between prostate and urethra	↓ compressibility Desire to urinate Urinary symptoms
Anterior	Cranial to caudal	Assess quality of release following anterior compression	Ventral fixation of plexus of Santorini, periprostatic fascia, and pubourethral ligaments	Uneven return upon compression
Lateral Test	Right and Left lateral prostate	Lateral glide bilaterally	Fixation of lateral prostatic fascia, levator ani muscles, periprostatic veins	↓lateral mobility
Longitudinal Glide	Cranial, caudal, and central	Cranial to caudal Caudal to cephalad Central caudal and cephalad	Global prostate assessment Extensibility of the urethra, prostate, and bladder neck	↓ mobility Fibrosis of urethra or periurethral tissues

cephalad to the pectinate line, and the prostate drain latero-superior into the internal iliac nodes (Solan et al., 2013; Swanson et al., 2013). Lastly, the upper 2/3 of the rectum drains superiorly into the inferior mesenteric nodes (Solan et al., 2013). Changes within the lymphatic flow can be found manually. Pudendal nerve artery pulse can also be palpated intrarectally inferior to the ischial spine, as well as medial to the ischial tuberosity internally or externally (Archambault-Ezenwa et al., 2016). A strong increase or decrease in pulse rhythm or intensity can be signs of vascular restriction or congestion.

2.1.5. *Physical therapy treatment*

A movement-based model was used to treat and rehabilitate all systems identified as dysfunctional. A multimodal approach was provided to each man in accordance with their physical findings from a comprehensive physical therapy evaluation. Treatment consisted of myofascial and trigger points release to the pelvic floor and lower quadrant musculature, visceral manipulation including the prostate, nerve manipulation, viscero-vascular manipulation, craniosacral therapy, exercises, progressive mental and muscle relaxation, autogenic training incorporating visualization/imagery of pelvic floor relaxation, and biofeedback. Table 3 indicates treatment applied to specific anatomical structures.

3. Results

Similarities in clinical presentation were found among men suffering from MCPPS. The symptoms experienced by the patients are reported in Table 4. The principal physical findings encountered during the manual assessment are depicted in Table 5.

The most prevalent physical characteristics (encountered in ten out of ten men) were decreased kidney, and femoral nerve mobility (restriction of the kidney and femoral nerve were ipsilateral in nine out of ten men), spasm of the levator ani, quadratus lumborum, and the iliopsoas muscles, as well as weakness of the levator ani muscles. The levator ani and external anal sphincter showed dysfunction in strength, tone, and coordination. The patient inability to coordinate the abdominal and the pelvic floor muscles while bearing down confirmed the dyssynergia and was recorded in 80% of the cases. Prostate mobility was decreased in all men (excluding one patient who underwent prostatectomy). Table 2 indicates the specificity of a comprehensive prostate assessment. Transrectal biofeedback showed a high resting baseline in 100% of cases with an average of 9.17 μV, ranging between 4.28 and 15 μV. Thoraco-lumbar hypomobility was recorded in 80% of men, without reproduction of pain. Pain with sitting was also present in eight out of ten patients, as well as in professions involving prolonged sitting (seven out of 10 patients sat >8 h per day). Anxiety was experienced by 70% of the patients, out of which 40% sought counseling. The reported pain triggers were bacterial prostatitis, surgery, intercourse, and weight training. Post-treatment, seven patients reported subjective symptom improvement of 50% or more following physical therapy treatment (see Table 6). Only one patient was reached by phone 1-year post-treatment and reported complete remission of symptoms.

Table 4
Symptoms, functional limitations, and medical history of ten patients presenting with MCPPS. L/Ext's: Lower extremities; B.M.: Bowel movement; L5: Lumbar 5.

Symptoms Experienced (n = 10)		Symptoms Experienced (n = 10)	
Pain sitting	8	Suprapubic pain	3
Pain with ejaculation/orgasm	6	Penile pain	3
Pain Walking	6	Urinary hesitancy	3
Pain inner thighs/L/Ext's	5	Abdominal bloating	3
Pain perineal body	5	Urinary urgency	2
Testicular pain	4	Urinary frequency	2
Straining with B.M.	4	Rectal pain	2
Pain with B.M.	4	Low stream of urination	1
Difficulty emptying B.M.	3	Dysuria	1
Medical History (n = 10)		Medical History (n = 10)	
Anxiety	7	Inguinal Repair	2
Gastroesophageal Reflux	3	Vasectomy	1
Varicocele repair	3	Prostatectomy	1
Depression	3	Appendectomy	1
Insomnia	2	Discectomy L5	1

Table 5
Physical findings found in 50% or more of ten MCPPS patients. BF: Biofeedback; *: Transrectal; Q.L: Quadratus Lumborum; ROM: Range of motion; T9-L3: Thoracic 9-Lumbar 3.

Physical Findings (n = 10)		Physical Findings (n = 10)	
High resting baseline BF*	10	↓Bladder mobility	9
Spasm Iliopsoas	10	Sacroiliac misalignment	8
Spasm Q.L.	10	Hip ROM asymmetry	8
Spasm gluteal/piriformis	10	↓Liver mobility	8
Spasm levator ani	10	Dyssynergia	8
Weakness levator ani	10	Hypomobility T9-L3	8
↓ Prostate mobility	9	Spasm obturator internus	7
(Prostatectomy)	1	Restriction inguinal canal	7
↓Kidney mobility	10	↓Sciatic nerve mobility	6
↓Femoral nerve mobility	10	↓Pudendal nerve mobility	5
Spinal misalignment	9		

4. Discussion

Common evaluative findings were identified in 80% of men with MCPPS. The thoraco-lumbar spine, the liver, the kidney, the bladder, the femoral nerve, the lower quadrant (iliopsoas, quadratus lumborum, and piriformis), and the pelvic floor muscles were affected in at least eight out of ten men. The prostate also showed decreased mobility in all men with a prostate. The predominant dysfunctional physical structures appear to be interrelated on an anatomical basis.

A mechanical relationship exists between the liver, the kidneys,

Table 3
Treatment utilized with men diagnosed with MCPPS.

Treatment Modalities
❖ Visceral Manipulation: Prostate, Bladder, Kidney, Liver, Inguinal canal, Colon/Sigmoid, Omentum, Common bile duct
❖ Myofacial Release/Trigger point Release: Iliopsoas, Levator Ani, Obturator Internus, Adductors, Quadratus Lumborum, Gluteal/Piriformis, Paraspinals
❖ Nerve manipulation: Femoral, Sciatic, Pudendal nerves, Dura, Brachial plexus
❖ Mobilization: Rib, Thoraco-Lumbar, Sacrum, and Coccyx
❖ Neuromuscular reeducation: Postural retraining, Levator Ani (contract relax with myofascial release during relaxation phase)
❖ Exercises: Stretching lower extremities, Core strengthening exercises
❖ Self-care: Relaxation with breathing exercise/Visualization pelvic relaxation, Eating habits, Voiding habits, Seating options
❖ Craniosacral: Temporal, Parietal bone
❖ Visceral Vascular manipulation: Pudendal artery, Aorta, Internal and external iliac arteries
❖ Biofeedback/Pelvic muscle reeducation

Table 6
Subjective improvement in symptoms reported by patients with MCPPS relating to number of visits, diagnosis, age, and pain onset from the initial physical therapy assessment. #: Number; PT: Physical therapy; CPP: Chronic pelvic pain; D/C: Discontinued; Tx: Treatment *Full remission of symptoms a year post physical therapy treatment.

Subjective Improvement in Symptoms	Diagnosis/Onset	Age	# of PT Visits
5 out of 10 men: ≥85%			
#1: 90%	Prostatitis/4 months	26	10
#2: 90%	CPP/8 years	35	21
#3: 90%	CPP post-prostatectomy/19 months	46	8
#4: 85% *	Bacterial prostatitis/2 months	41	4
#5: 85%	Prostatitis/8 months	34	9
2 out of 10 men: 50–60%			
#6: 60% (D/C Tx)	Pudendal neuralgia/24 months	24	6
#7: 50% (D/C Tx)	Testicular pain/24 months	24	6
2 out of 10 men: 10–15%			
#8: 15% (D/C Tx)	Testicular pain post-vasectomy/24 months	40	4
#9: 10% (D/C Tx)	Levator ani spasm/24 months	33	5
1 out of 10 men: non-quantified			
#10: ? (D/C Tx)	Prostatitis/9 years	40	3

the bladder, and the prostate (Hickling et al., 2015). The ureters connect the kidneys to the bladder and are located anterior to the psoas muscle and the common iliac artery. The hepatorenal ligament connects the liver to the right kidney. The liver also joins the bladder though a chain of connective tissue. The falciform ligament initially inserts into the liver and blends with the umbilical ligaments at the level of the umbilicus, which in turn connects to the bladder though the prevesical cul-de-sac (Hickling et al., 2015; Abdel-Misih et al., 2010). The pubovesical and the puboprostatic ligaments arise from the postero-inferior surface of the pubic bone and attach to the bladder and the prostate respectively. The neck of the bladder is fixed by the endopelvic fascia and is in direct contact with the base of the prostate (Hickling et al., 2015). Finally, the urethra exiting the bladder traverses the prostate and extends into the penis (see Fig. 4). Restriction of any of the above-mentioned structures may impact organ function and create pain (Brüggmann et al., 2010). Urinary symptoms were reported by 50% of men.

An interesting link exists between the left kidney to the left testicle. The left testicular vein, as well as the second left lumbar vein empties into the left renal vein, unlike the right testicular vein which drains into the inferior vena cava (Barral, 2010). Restrictions or adhesions between the two points could create engorgement within the left testicle. The posteromedial portion of the kidney rests on the psoas muscle. This muscle appears to be hypertonic in all men participating in this study and could greatly contribute to the pain experienced by men with MCPPS (Hetrick, 2003).

The lumbar plexus innervates the lower extremities and the pelvic region and is adjacent to the kidneys. The kidneys, the bladder, and the ureters also share common thoracolumbar innervation (Hickling et al., 2015). The iliohypogastric nerve (T12-L1), the genitofemoral (L1-L2), and the ilioinguinal (T12-L1), nerves all originate from the lumbar plexus at the thoracolumbar junction (see Fig. 5) (Anloague et al., 2009).

These nerves cross the psoas or lie between the psoas and the quadratus lumborum, and connect to the obliques, and then enter into the inguinal canal, innervating the upper part of the lower extremities and the genitals (see Fig. 6).

The vas deferens accompanies these nerves into the canal, and restriction, creating nerve compression and/or irritation, could become a source of pain. This may explain why 50% of men reported lower extremity pain. The femoral nerve (L2-4) meets the inferior pole of the kidney, between the iliacus and the psoas, and they can affect each other, especially when kidney ptosis is present. The nerve then crosses underneath the inguinal ligament and innervates parts of the lower extremity (Anloague et al., 2009). The obturator nerve (L2-4) follows the femoral nerve medially, passes anterior to the sacro-iliac joint under the pubic ramus, between the pubic tubercle and the femoral artery. Then the nerve crosses through the obturator canal bordered superiorly by the pubic bone, and inferiorly by the obturator internus muscle, and innervates the adductor muscles. Therefore, spasm of the obturator internus

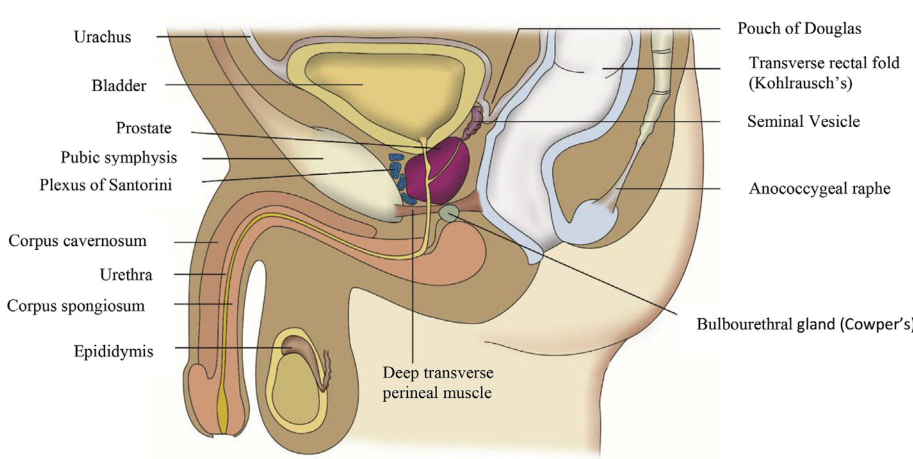

Fig. 4. Location of the prostate. From *Manual Therapy for the Prostate*, published by North Atlantic Books and The Barral Institute. Copyright © 2010 by Jean-Pierre Barral. Reprinted by permission of the publisher (Barral, 2010).

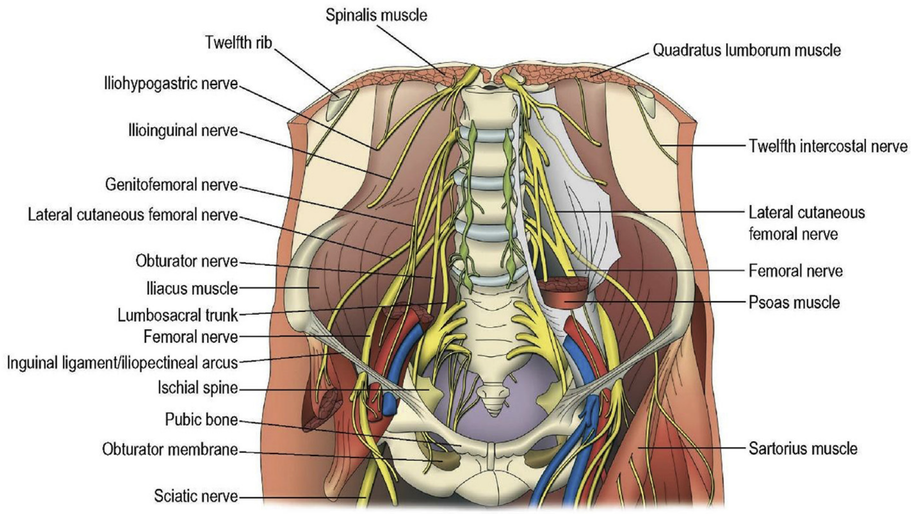

Fig. 5. Lumbar plexus. Copyright image courtesy of The Barral Institute and Barral Production's *Manual Therapy for the Peripheral Nerves* (Barral, 2007).

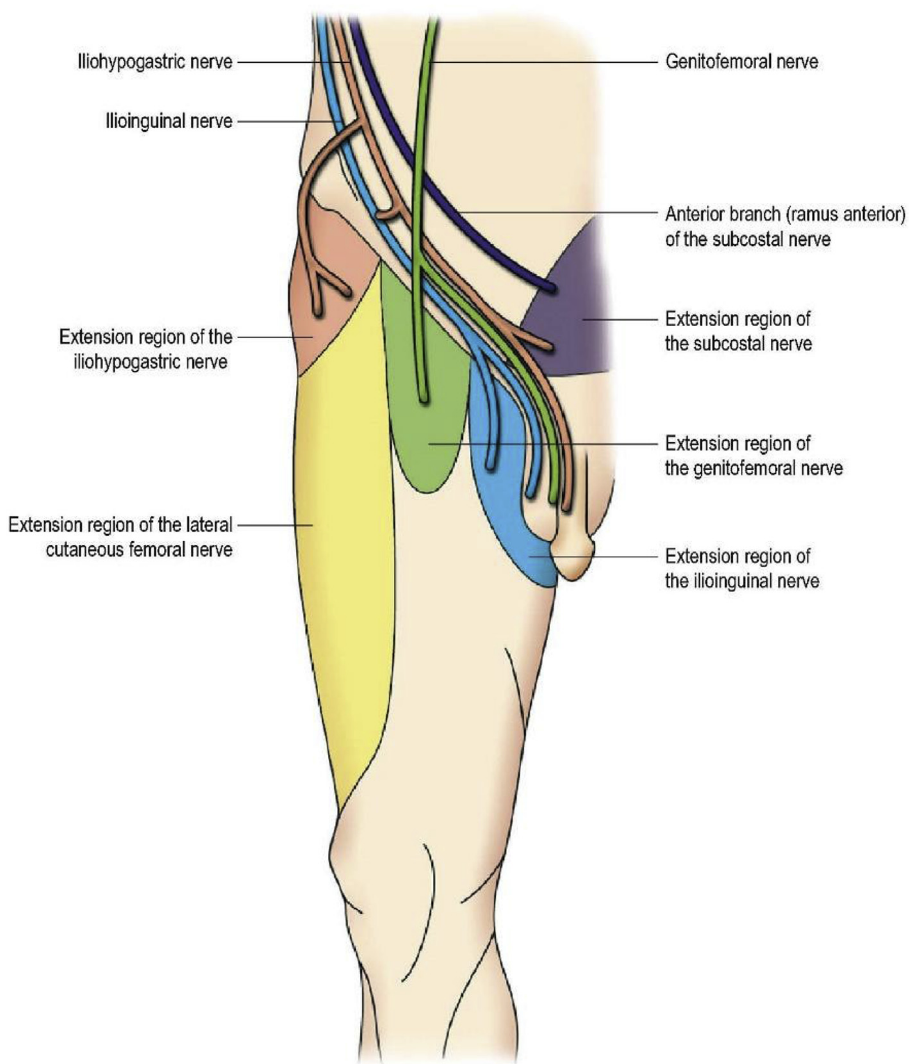

Fig. 6. Sensory supply of genitofemoral nerve. Copyright image courtesy of The Barral Institute and Barral Production's *Manual Therapy for the Peripheral Nerves* (Barral, 2007).

muscle could irritate the obturator nerve and elicit pain and hypertonicity to the inner thighs. Every lumbar nerve receives two rami communicants from the grey matter, and only L1 and L2 receive one from the white matter of the spinal cord. Additionally, spasm of the iliopsoas and quadratus lumborum muscle found in this study, originating at the lumbar spine, may contribute to spinal asymmetry and pain. Ten out of ten men experienced spasm to both muscles. These anatomical associations clearly demonstrate the importance of assessing the thoracolumbar junction and its neighboring structures.

The prostate is surrounded by an extensive vascular system; anteriorly by the vein of the urethra and the bladder, the plexus of Santorini, and the vein of the bulb of the penis; posteriorly by the hemorrhoidal veins; and surrounding the prostate, by the periprostatic veins (Barral, 2010; Raychaudhuri et al., 2008). Chronic pelvic floor muscle spasm may contribute to the increase in pelvic congestion noted on ultrasound (Dellabella et al., 2006; Wasserman, 1999). The venous system of the hemorrhoidal vein (also referred to the rectal vein) ultimately drains into the portal vein, within the liver (Solan et al., 2013; Abdel-Misih et al., 2010). Therefore, any restrictions within the surrounding liver fascial system may cause backflow to the rectal area, propagating venous stasis. Although literature shows the vascular system involvement in MCPPS, assessment of the pelvic lymphatic drainage and vascular system was not consistently recorded in all cases to include in this study. Nevertheless, it could provide critical information regarding pelvic congestion and arterial changes encountered in sonograms (Swanson et al., 2013; Dellabella et al., 2006; Wasserman, 1999).

The prostate innervation is provided by the presacral nerves comprising the hypogastric nerves (Solan et al., 2013). The hypogastric plexus also forms anastomosis with the lumbar and sacral sympathetic chain and the sacral plexus. The sacral plexus gives birth to the pudendal plexus. Mechanical lumbar dysfunction and/or lumbar surgery could potentially affect the pudendal nerve through its anastomosis. One patient had undergone lumbar surgery prior to the beginning of his symptoms. The pudendal nerve travels through the pelvis, contacting the obturator internus muscle and crossing in between the sacrotuberous and sacrospinous ligaments. An especially crucial point within the pelvic floor support system is the ischial spine where the sacrospinous ligament, the tendinous arch of the levator ani, the iliococcygeus, piriformis, obturator internus, and the coccygeus muscles insert (Barral, 2010). This area has been reported as a key site where pudendal nerve impingement is encountered which could elicit pain within the perineum. Interestingly, 50% of men in this study showed decreased pudendal nerve mobility. The endopelvic fascia, covering the pelvic floor muscles, and the visceral fascia, surrounding the prostate, are closely interrelated (see Fig. 7) (Barral, 2010; Raychaudhuri et al., 2008).

Anteriorly, the periprostatic fascia connects to the external urethral sphincter. Laterally, the lateral prostatic fascia merges with the endopelvic fascia and fibromuscular extensions of the levator ani muscles. Posteriorly, the prostate relates closely to the rectum and is separated by the prostatoperitoneal aponeurosis of Denonvilliers (also called the rectoprostatic fascia). Levator ani muscle spasm was found in all ten men in this study and could have contributed to the fascial restriction encountered within the prostatic fascia.

A systematic manual prostate mobility assessment is clearly delineated in Table 2 and may be used to guide newly trained pelvic floor therapists, and as a standard prostate assessment for research purposes (Barral, 2010). Ultrasound has confirmed pelvic floor and kidney mobility respectively (Khorasani et al., 2012; Michallet, 1986). Electromagnetic tracking of the prostate mobility in relationship to respiratory motion was assessed in a prone and supine position for specificity during radiotherapy (Shah et al., 2011). However, quantitative measurement of normal prostate mobility during manual assessment, physical exercise, and/or daily activity has yet to be determined. Could restriction in prostate mobility contribute to the pain cycle of men suffering from MCPPS? Research has shown the immediate hypoalgesia effect of visceral manipulation (McSweeney et al., 2012). Subsequent research is necessary to corroborate any level of association between prostate mobility restriction and pain experienced by MCPPS patients. Despite the fact that the prostate assessment depends greatly on the therapist's palpatory skills and bilateral comparison, the results can help depict neighboring dysfunctional structures.

The close anatomical relationship of the described systems and the specific evaluative findings present in all men in this study

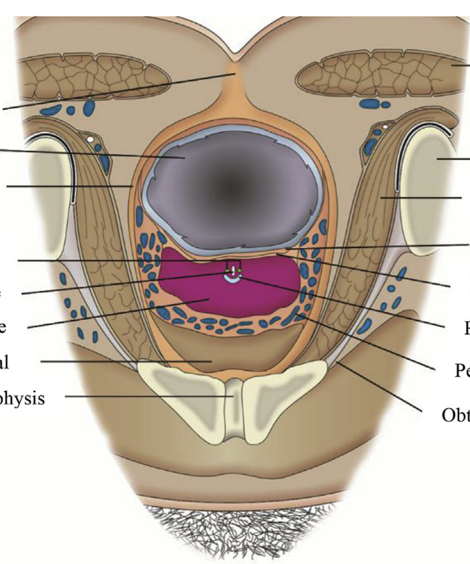

Fig. 7. Prostatic compartment. From *Manual Therapy for the Prostate*, published by North Atlantic Books and The Barral Institute. Copyright © 2010 by Jean-Pierre Barral. Reprinted by permission of the publisher (Barral, 2010).

supports the importance of a comprehensive, movement-based assessment. An inflammatory process with potential for adhesions from many sources (including surgeries (seven out of ten men had undergone lower quadrant surgery), an infectious process (one man had acute bacterial prostatitis), musculoskeletal injury from trauma, exercise, and sexual activity (reported by three men)) could affect the above-mentioned structures and disrupt the fascial chain, thus impairing their function and mobility and becoming a source of pain (Brüggmann et al., 2010). The intricacy of these anatomical interrelationships contributes to the complexity of this syndrome.

Brain MRI has shown spontaneous activation of the insula within the brain (Farmer et al., 2011). Interestingly, the insula has been identified as an area which processes visceral pain and is also part of the motor cortical representation of a pelvic floor contraction (Schrum et al., 2011; Song et al., 2006). The levator ani muscle was recorded to be hypertonic in all men. Did the chronicity of the increase tone of the pelvic floor muscles compressing the prostate modulate the brain patterns found in the MRI of men with MCPPS? Further research assessing the impact of pelvic floor rehabilitation, including prostate manipulation, on brain modulation could shed light on the pain mechanism associated with MCPPS. Seven out of ten men is this study reported decrease in pain levels post treatment.

Signs and symptoms relating to constipation and dyssynergia have been reported in 40–80% of the cases, corroborating what has been reported in the literature (Hetrick DC et al., 2003). Therefore, it is important to complete a thorough assessment of pelvic floor dyssynergic patterns (Archambault-Ezenwa et al., 2016). Chronic straining may lead to additional disorders such as hemorrhoids and rectal prolapse, which could further aggravate pelvic floor dysfunction (Bocchini et al., 2010; Lohsiriwat, 2012; Lubowski DZ et al., 1988).

Environmental factors including prolonged daily sitting at work and pain with sitting, were present in 80% of the patients. Future investigation of the impact of prolonged sitting and stress on prostate health should be pursued. The development of a MCCPS-validated questionnaire to help classify patients according to the UPOINT classification, and perhaps the incorporation of sitting tolerance as a functional measure in the diagnosis of MCCPS should be considered. Additionally, potential pain triggers reported by patients, including sexual practice, weight training, and lower quadrant surgeries, warrant further exploration.

A multisystem approach may aid in the maturation of a comprehensive standardized evaluation process. Future research, performed on a broader scale, is needed to evaluate the multisystem inter-rater reliability and scrutinize the correlations between the UPOINT classification, prostatic physiological changes noted on diagnostic imaging pre-and-post prostate manipulation, brain modulation, and physical findings from a multisystem assessment. This process could help clinicians understand the physiological impact that prostate manipulation has on the prostate and identify which additional UPOINT domain would primarily benefit from pelvic floor rehabilitation.

4.1. Limitations

In light of the fact that this was a retrospective study we had to exclude the use of validated questionnaire data because of the lack of consistency in adequate completion of the questionnaires pre and post treatment by the participants, and instead patient subjective improvement and a functional assessment questionnaire was used (Appendix 1). Additionally, inter-rater assessment reliability was not integrated as the assessment and treatment protocol were performed by a single therapist. This is a result of using real-world cases for this study, and future studies should ensure appropriate researcher deployment and blinding. Lastly, our results were not statistically significant due the small number of participants.

5. Conclusion

The observations in this retrospective study demonstrate that the use of a multisystem assessment approach in patients with MCPPS is critical for their more effective treatment. As demonstrated in the results, the range of additional dysfunctions including impaired prostate mobility was identified in all cases. This, and the cases' subsequent follow-up findings, suggests that current physical therapy referrals could be expanded to more than one UPOINT domain to avoid limiting the recovery of patients displaying dysfunctions stemming from other systems. On the basis of these findings, and the close mechanical interrelationships of the anatomical elements involved and multisystem MCPPS etiologies, larger-scale research is warranted.

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Conflicts of interest

Dr. Archambault-Ezenwa works in private practice and specializes in pelvic floor dysfunctions. She has published and presented her work on topics related to pelvic floor dysfunction at conferences. Dr. Markowski works in a physical therapy private practice, is a published author, and has presented at many conferences. Dr. Barral is the founder of BOTO (Barral Osteopathic teaching organization in France) and the Barral Institute in the US. He teaches for both organizations, and has published on topics, including manual therapy for the prostate, visceral, and neural manipulation.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jbmt.2019.05.021.

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