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MALE PELVIS

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The Male Pelvis In Sagittal View: A Comprehensive Anatomical Insight Across Modalities

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ABSTRACT

Introduction: The male pelvis is a critical anatomical region involved in multiple physiological systems, including urinary, reproductive, and gastrointestinal functions. A thorough understanding of its sagittal anatomy is fundamental for clinicians, radiologists, and educators in various medical disciplines.

Methods: This study provides an in-depth examination of the sagittal section of the male pelvis through four distinct visualization modalities: traditional anatomical diagrams, CT imaging, the Anatomage virtual dissection table, and cadaveric dissection. Each modality was assessed for its contributions to anatomical understanding, with a focus on clarity, precision, and clinical relevance.

Results: The comparative analysis of these visualization techniques highlights their respective strengths and limitations. Traditional anatomical diagrams offer foundational clarity, while CT imaging and virtual dissection enhance spatial understanding and interactivity. Although cadaveric dissection provides realistic anatomical details, it is limited by accessibility and practical constraints.

Discussion: Clinical applications of sagittal pelvic imaging include enhanced diagnostic capabilities for conditions such as benign prostatic hyperplasia, prostate cancer, rectal tumors, and pelvic trauma. The integration of traditional and advanced visualization methods fosters a multidimensional approach to anatomical learning, improving both clinical practice and educational outcomes.

Conclusion: The combination of multiple visualization modalities significantly enriches the understanding of male pelvic anatomy, providing a robust tool for clinical practice and educational development. These approaches contribute to more effective training, diagnosis, and treatment planning in medical fields.

Keywords: Male Pelvis, Sagittal Anatomy, Medical Imaging, Prostate Cancer, Anatomical Education, Clinical Diagnosis

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INTRODUCTION

The male pelvis is a complex osseous and soft tissue anatomical region housing essential components of the urinary, reproductive and digestive systems. Understanding its structure through various perspectives is crucial for both anatomical education and clinical practice. Its anatomical configuration, particularly when observed in the sagittal plane, offers a unique and detailed perspective of spatial relationships among pelvic organs, neurovascular structures, and the musculoskeletal framework. Understanding this sagittal anatomy is not only fundamental to clinical practice but also critical in the realms of surgery, radiology, and educational anatomy. Knowing the theory of the anatomy and the physiology of the male pelvis is the first step in becoming clinically competent [1].

This article explores the sagittal section of the male pelvis using four complementary modalities: Traditional Anatomical Diagrams from Dissectors, the Anatomage Virtual Dissection table, Sagittal CT Imaging and Cadaveric Visualization. Together these approaches provide a comprehensive and multidimensional understanding of Male Pelvic Anatomy.

The sagittal view provides an anteroposterior cross section that delineates the alignment and positioning of structures such as the urinary bladder, prostate gland, rectum, seminal vesicles, and the bony pelvis [2]. Traditional Anatomical Diagrams from Dissector manuals remain foundational resources in gross anatomy education. CT provides high-resolution bony detail. Through virtual Anatomage table, touch-interactive digital cadaver allows users to explore the male pelvis in sagittal slices with remarkable clarity and manipulability. Despite the rise of digital tools, Cadaveric dissection remains the gold standard for spatial and tactile understanding.

This comprehensive review aims to bridge the anatomical knowledge with modern diagnostic and educational imaging techniques, offering an integrative understanding of the male pelvis in sagittal orientation. It emphasizes the clinical relevance of this view in the diagnosis and management of conditions such as benign prostatic hyperplasia, rectal tumours, pelvic trauma, and congenital anomalies. By comparing the depiction of pelvic anatomy across different modalities, this work also seeks to enhance interpretative accuracy and anatomical literacy among clinicians, radiologists, and students alike.

ANATOMICAL OVERVIEW OF THE MALE PELVIS

The pelvic cavity is a space that is limited by pelvic walls and communicates upward with the abdominal cavity. The pelvic floor is created by two diaphragms: pelvic and urogenital. It divides the pelvic cavity into supra-diaphragmatic and infra-diaphragmatic parts. Peritoneum in the males descends from the anterior abdominal wall and runs over the bladder and descending from its posterior surface it migrates toward the anterior rectum forming the rectovesical pouch [3]. The male pelvic intraperitoneal space contains bowels, appendix and lower sigmoid colon.

Pelvic Bones – The pelvis is formed by the fusion of three bones: ilium, ischium and pubis, which converge at the acetabulum on each side [4]:

- **Ilium**: The broad, flaring upper portion of the pelvic bone.
- **Ischium**: Forms the posteroinferior part of the hip bone.
- **Pubis**: The anterior portion that meets its counterpart forming the pubic symphysis.

The two hip bones articulate with:

- Sacrum posteriorly at the sacroiliac joints, and
- With each other anteriorly at the pubic symphysis.

Pelvic Regions – The pelvis is divided into [5]:

- **Greater (False) Pelvis**: Above the pelvic brim; supports abdominal organs.
- **Lesser (True) Pelvis**: Below the pelvic brim; contains pelvic organs such as the bladder and rectum.

Male Pelvic Characteristics – Compared to the female pelvis, the male pelvis has [6]:

- Narrower and taller structure.
- Heavier and thicker bones.
- Smaller, heart-shaped pelvic inlet.
- Narrower subpubic angle (<70 degrees).
- Longer and more curved sacrum.

Pelvic Organs in Males

A. Urinary System

- **Urinary Bladder**: Lies posterior to the pubic symphysis.
- **Urethra**: Passes through the prostate and penis; divided into [7]:
    - Prostatic urethra
    - Membranous urethra
    - Spongy (penile) urethra

B. Reproductive System [8]

- **Testes**: Located in the scrotum; produce sperm and testosterone.
- **Epididymis**: Stores and matures sperm.
- **Vas deferens**: Carries sperm from epididymis to ejaculatory ducts.

- **Seminal Vesicles**: Posterior to bladder; secrete a fluid that forms most of semen.
- **Prostate Gland**: Surrounds the prostatic urethra; secretes prostatic fluid.
- **Ejaculatory Ducts**: Formed by union of vas deferens and seminal vesicles; empty into urethra.
- **Bulbourethral (Cowper's) Glands**: Located near the membranous urethra; secrete a lubricating mucus.

Pelvic Floor Musculature

These muscles form the pelvic diaphragm, which spans the pelvic outlet. The musculature supports the pelvic organs and maintains continence. The major muscles are:

- **Levator ani group** (pubococcygeus, puborectalis, iliococcygeus)
- **Coccygeus muscle**

The subperitoneal space is limited from above by the parietal peritoneum. Its inferior limitation is the pelvic floor. The space connects supero-anteriorly and superoposteriorly with the preperitoneal and retroperitoneal spaces respectively.

The subperitoneal space comprises [9]:

1. Urinary bladder
2. Pelvic portions of ureters
3. Part of the urethra
4. Rectum
5. Internal iliac arteries together with their ramifications
6. Internal iliac veins with tributaries
7. Lymphatic vessels and sacral, internal iliac, and pelvic lymph nodes
8. Sacral plexuses with their nerves
9. Pelvic portions of sympathetic trunks with their rami
10. Hypogastric nerves
11. Pelvic splanchnic nerves
12. Inferior hypogastric plexuses and their subsidiary rami
13. Obturator nerves
14. Prostate
15. Pelvic portions of ductus deferens
16. Seminal vesicles
17. Ejaculatory ducts

Posteriorly and laterally, the pelvic cavity communicates with the subgluteal space through greater and lesser sciatic foramina.

Greater and Lesser Sciatic Foramina

The greater sciatic foramen is divided into two compartments by the piriformis muscle: the supra- and the infra-piriform foramina.

- The suprapiriform foramen is traversed by the:
  - Superior gluteal nerve
  - Superior gluteal artery with comitant veins and lymphatics

- The infrapiriform foramen communicates the pelvis with the subgluteal space. It is traversed by the following:
    - Inferior gluteal nerve
    - Inferior gluteal vessels and lymphatics
    - Pudendal nerve
    - Internal pudendal artery with comitant veins
    - Sciatic nerve
    - Posterior cutaneous nerve of the thigh

The lesser sciatic foramen communicates the subgluteal space with the pelvic cavity and contains the following:

- Obturator internus muscle
- Pudendal nerve
- Internal pudendal artery with comitant veins and lymphatics

Subcutaneous Space

The subcutaneous space is located beneath the pelvic floor and represents the inferior, infra-diaphragmatic part of the pelvic cavity. It is bounded:

- Laterally by the pelvic walls covered with muscles
- Inferiorly by the perineal skin

This space lies adjacent to the perineal region, which is anatomically divided as:

- Posterior perineal region – adjacent to the anal area
- Anterior perineal region – adjacent to the urogenital area

Subdivisions of the Subcutaneous Space:

1. Anterior Perineal Area – further divided by the perineal membrane into:
    - Deep perineal space: located above the perineal membrane
    - Superficial perineal space: located below the perineal membrane
2. Posterior Perineal Area – includes the right and left ischioanal fossae

Deep perineal space is a potential space with the following boundaries:

- Above: superior fascia of the urogenital diaphragm
- Below: inferior fascia of the urogenital diaphragm (or perineal membrane)
- Bilaterally: inferior fragment of the obturator fascia, ischial ramus, and inferior pubic ramus

Contents of Deep Perineal Space in Males:

- Membranous urethra
- Deep transverse perineal muscle
- External urethral sphincter

Neurovascular Supply

- Sacral Plexus: Supplies lower limbs and perineum
- Pudendal Nerve: Main nerve of the perineum; essential for motor and sensory control of the pelvic floor and external genitalia

Arterial Supply:

From the Internal Iliac Artery and its branches:

- Superior and Inferior Gluteal Arteries
- Internal Pudendal Artery
- Vesical Arteries
- Prostatic Branches

Venous Drainage:

- Veins accompany corresponding arteries and drain into the internal iliac vein

Modalities of Visualization

A. Labelled Diagram from Dissector Modules

Standard anatomical diagrams provide stylized, labelled views of the pelvis that emphasize major structures, offering clarity and simplicity. These are ideal for beginners due to reduced complexity and high consistency across sources. However, they lack real anatomical variability and depth.

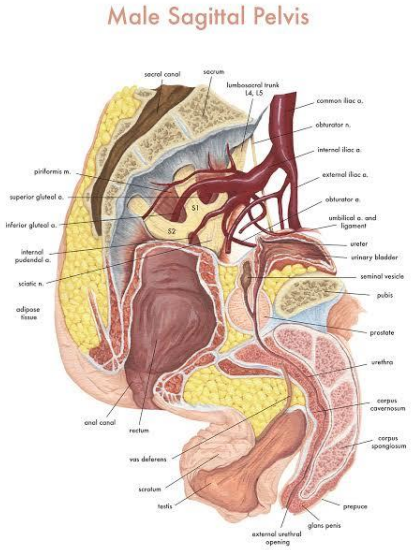

Fig. 1 Source: Netter's Atlas

B. CT Scans of Sagittal Section

Sagittal CT imaging reveals the male pelvis in cross-sectional radiological anatomy. It displays anatomical variations, soft tissue densities, and detailed bone structures. This modality plays a pivotal role in bridging theoretical knowledge and clinical practice.

- It aids in distinguishing organs such as the bladder, rectum, and prostate from surrounding tissues.
- CT scans contribute to the understanding of complex spatial anatomy and the diagnostic relevance of extraperitoneal pelvic spaces, which are often difficult to identify in cadaveric dissection [10].
- Sagittal CT also demonstrates contrast movement patterns in spaces like the space of Retzius posterior to the pubic symphysis [11].
- The pelvic extraperitoneum remains less well understood than the abdominal retroperitoneum, yet is critical for recognizing disease spread and inter-compartmental communication [12], [13].

Fig. 2 Source: From Internet

C. Image from Virtual Dissection Table

The Anatomage Table provides a high-resolution, touch-interactive 3D digital cadaver.

- In the sagittal view, users can layer, isolate, and study pelvic organs (e.g., bladder, rectum, prostate) with surrounding musculature and vessels.
- It simulates cadaver dissection without physical limitations, enhances spatial orientation, and offers repeatable, realistic training experiences.

Fig. 3 Source: Photographed by Authors from Anatomage Table

D. Specimen from Cadaver Dissection

Cadaver sagittal sections provide realistic textures, colors, and spatial relationships that no digital model can fully replicate.

- These offer the most authentic learning tool for anatomical orientation and pathology correlation.
- Limitations include institutional and ethical access restrictions, but their educational value remains unmatched.

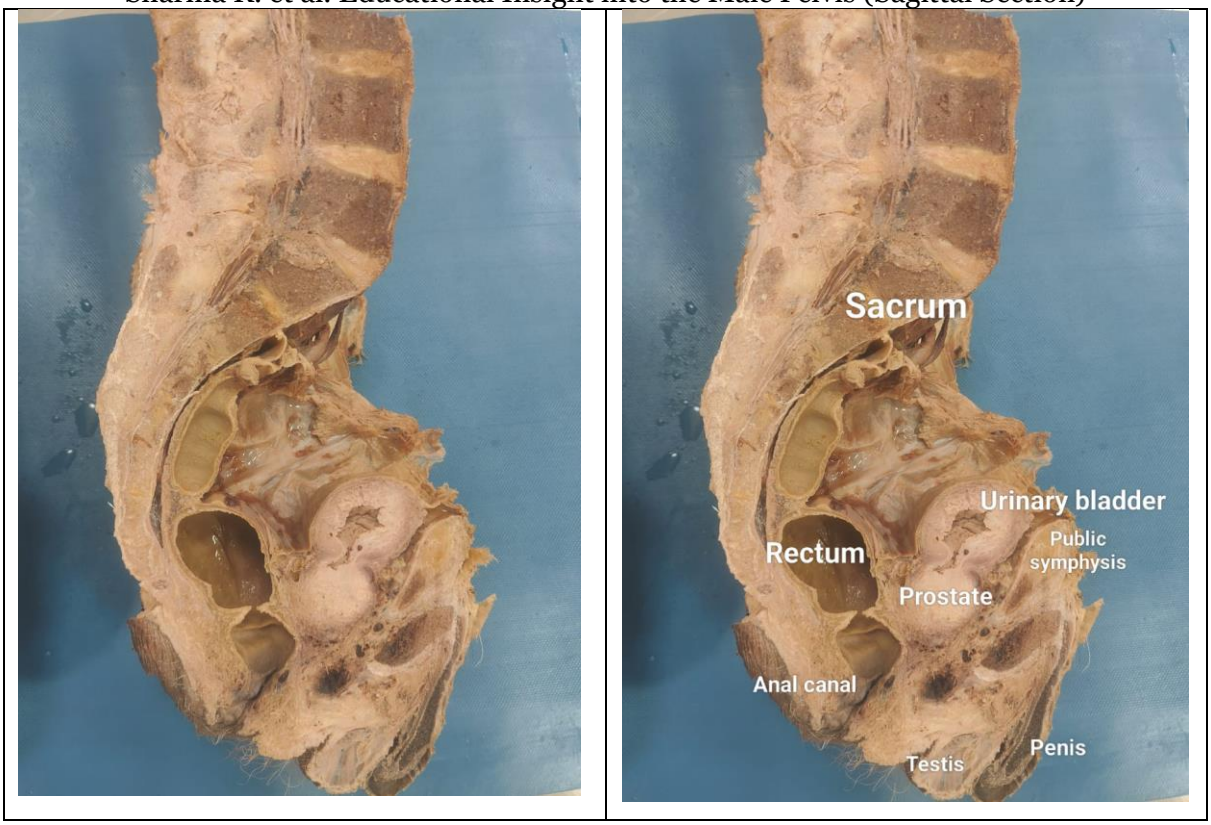

Fig. 4, Fig. 5 with labeling; Source: Photographed by authors during regular dissection work in Department of Rachana Sharir

COMPARATIVE ANALYSIS TABLE OF FOUR MODALITIES

A comparative analysis of four educational modalities—Diagram, Anatomage, CT scans, and Cadaveric Dissection—highlights their respective strengths and limitations in teaching the male pelvis in sagittal view. In terms of clarity of anatomical structures, the Anatomage table stands out with very high clarity, followed by Diagram and Cadaveric Dissection, both rated as high, while CT scans offer only moderate clarity.

Regarding clinical relevance, CT scans are considered very relevant, whereas Anatomage and Cadaveric Dissection are deemed relevant, and Diagrams are seen as having medium relevance. Interactive learning is a unique strength of the Anatomage modality, being the only one to support this feature, while the other three lack interactivity. Accessibility varies across modalities: Diagrams are easily accessible, CT scans vary in availability, Cadaveric Dissection is limited, and Anatomage is not easily accessible due to cost and availability constraints.

Lastly, when evaluating the clarity of pelvic extraperitoneal spaces, CT scans provide the highest clarity, followed by Anatomage (good), Diagrams (medium), and Cadaveric Dissection, which does not offer clear visualization of these spaces.

Table 1: Comparative Analysis of Four Modalities

S.no.	Feature	Diagram	Anatomage	CT Scans	Cadaveric Dissection
1	Clarity of Structures	High	Very High	Moderate	High
2	Clinical Relevance	Medium	Relevant	Very Relevant	Relevant
3	Interactive Learning	No	Yes	No	No
4	Accessibility	Easily accessible	Not easily accessible	Varies	Limited
5	Clarity of Pelvic Extraperitoneal Spaces	Medium	Good	Very High	No

CLINICAL CORRELATIONS

Understanding the sagittal anatomy of the male pelvis plays a critical role in diagnosing and managing several common urological and gastrointestinal pathological conditions:

1. **Benign Prostatic Hyperplasia (BPH)**: Sagittal views help visualize the enlargement of the prostate gland, which compresses the urethra and alters the shape of the bladder base. Imaging studies, particularly sagittal ultrasound and CT scans, provide insight into the degree of obstruction and guide management decisions [14].
2. **Prostate Cancer**: Sagittal MRI and CT views are essential in staging prostate cancer, allowing assessment of extracapsular extension, seminal vesicle invasion, and involvement of adjacent structures. They guide biopsy approaches and surgical planning, especially for nerve-sparing prostatectomies [14].
3. **Rectal Masses and Cancer**: Sagittal imaging is key in determining the anterior displacement of the prostate or bladder by rectal tumors. MRI is preferred, offering detailed tissue contrast, but sagittal CT remains valuable for initial assessment and staging [14].
4. **Urethral Strictures and Pelvic Trauma**: In trauma cases, sagittal imaging helps evaluate pelvic fractures and their relationship with the membranous urethra and prostate. This orientation is crucial for surgical repair and planning [14].
5. **Surgical Planning and Intervention**: Procedures such as transurethral resection of the prostate (TURP), cystoscopy, and laparoscopic pelvic surgery rely on a sound understanding of sagittal

anatomy. Virtual models and preoperative CT/MRI assist in minimizing complications [14].

6. **Correction of Spinal Deformity**: Sagittal plane alignment is increasingly recognized as a critical parameter in the setting of adult spinal deformity. Additionally, pelvic parameters reveal to be a key component in the regulation of sagittal alignment [15].

EDUCATIONAL IMPLICATIONS:

Integrating multiple anatomical visualization techniques fosters a richer and more durable learning experience. Traditional anatomical illustrations serve as foundational tools, promoting initial comprehension of organ structures and spatial relationships. However, supplementing these with interactive tools like the Anatomage Table and diagnostic imaging creates a more immersive and contextual understanding of anatomy.

Virtual dissection tables such as Anatomage provide high-resolution, manipulable models that enhance spatial awareness and student engagement. Studies have shown that these tools significantly improve student confidence and performance in anatomical identification [16]. Similarly, correlating anatomy with clinical imaging, like CT or MRI, bridges the gap between preclinical education and real-world application, reinforcing clinical relevance [17].

Furthermore, multimodal learning aligns with adult learning principles and cognitive load theory, enabling better retention and retrieval of complex anatomical information. A review emphasized that students exposed to a variety of visual modalities developed stronger anatomical reasoning and diagnostic interpretation skills [18].

Educational Integration can progress the learning procedure as shown in flow diagram below (created by Author for better understanding)-

In essence, the evolution of anatomical education lies in the synergy between classical methods and contemporary technology. This integrated approach not only prepares students for clinical encounters but also promotes lifelong learning and adaptability in medical practice.

CONCLUSION:

The male pelvis in sagittal view serves as a foundational topic in both anatomical education and clinical training. By exploring this region through diagrammatic, virtual, radiological, and cadaveric lenses, learners gain a layered and functional appreciation of its structure. Multimodal learning not only enhances comprehension but also bridges the gap between classroom theory and clinical reality.

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