Preface

I’m really happy that you have decided to purchase this book! Not because I’m going to receive a commission from the sale, but because you are genuinely serious about learning and mastering the information in *Beyond Pain: A Comprehensive Pain Board Review*. Although it is not necessary to own both copies in order to prepare for your pain board certification exam, I find that the two books complement each other in such a way that they enhance the learning process significantly.

This study guide is a highly focused summary of the major ideas found in the board review book. By boiling chapters down to their essence, this study guide will give you the framework to build on as you learn new facts. Each chapter of this book correlates directly with the same chapter in the board review book in order to assist the reader in correlating the information obtained from both resources easily and quickly.

What you will find at BeyondTheBoards.com and specifically in *Beyond Pain: The Study Companion* is a complete and thorough review of the material you need to know in order to achieve top notch knowledge in the field of Pain Management. My intention is to completely immerse you in the field and keep you continuously updated so that you can achieve superior knowledge that can be utilized during your clinical career. In addition, my goal is not only to help you prepare for what lays ahead, but to provide you with the knowledge needed to continue to succeed throughout your career and beyond.

It is clear that medicine is as much a business as it is an art. Yet, we receive no education in Asset Protection, Tax Reduction, and Wealth Preservation during our medical training. While my intention is to help you prepare for your board certification exam, I also intend on helping you learn more about business and finance as it relates to physicians. So, study hard, use the resources available to you here and once you've passed the boards as I'm sure you will with persistence and dedication, come back and visit us at BeyondTheBoards.com for further education.

Finally, if there are any comments or recommendations for improvement with respect to this board study material, if there are any mistakes that should be corrected, or if any changes have occurred of which I am not aware, please help me and your colleagues stay updated by contacting me through my website.
I would like to dedicate this book to my lovely and caring wife Rien who has continuously supported me through this endeavor and has motivated me to shift out of “park” and into “drive”!
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READ THIS SECTION!

How to Use This Book

_Beyond Pain: The Study Companion_ is designed to test your knowledge and solidify the information learned in the Board Review Book. It is designed to work in synchrony with the Board Review Book and as such no answers are provided in this study companion. This book correlates each chapter with the same chapter found in Beyond Pain’s Board Review Book and utilizes multiple testing formats in order to drive the information home and make it stay there!

The test formats utilized include fill in the blanks which will focus your attention on gaps in your knowledge, matching questions which will help you build associations between related terms and facts, true or false statements which will force you to solidify your core knowledge, and finally short paragraph answers which will challenge you to consolidate your learning and to master key concepts from the text. Multiple choice questions are rarely used because that specific testing format is mostly passive and does not promote active learning. It is easy to fool yourself about how much you are remembering as you read and choose the “best” answer. The testing format employed in this *Study Companion* will help you actively process information, so that you can recall and apply what you know more quickly and effectively.

The Study Plan

Begin each day by reading a chapter of _Beyond Pain: A Comprehensive Board Review_ and taking notes based on each section of the chapter. If you resort to highlighting, you may find yourself highlighting entire pages so I would refrain from that specific study technique. At the end of your study session, review your notes and then go back and review the contents of the chapter you read the day before. Now, open up _The Study Companion_ and go through the corresponding chapter from the day before to test your knowledge. This gives you the chance to practice recalling facts from your reading, after you’ve closed the book. I would recommend that you review each Board Review Book chapter _at least_ three times. There are 38 chapters in the review book, if you study one chapter per day, and review the book in its entirety three times, you will require approximately 120 days (that’s four months!) so do not procrastinate. If you truly know all the material in this book, not only will you guarantee your ability to pass the board examination, you will also become a better physician. The study plan outlined above is not an easy one, but then again nothing worth having ever comes easy!
Anatomy of the Brain and the Cranial Nerves

1. Write the name of the structure and any associated Cranial Nerves in the image below:
2. Review the Thalamus in *Beyond Pain* and fill in the blanks below:

![Thalamus Diagram](image)

3. Where is CSF produced? Trace the path of CSF utilizing the following structures: Interventricular foramen of Monro, Aqueduct of Sylvius, foramen of Luschka, and foramen of Megendie.
a. CSF bathes the spinal cord and is reabsorbed by spinal epidural veins into the general circulation.  

TRUE or FALSE

4. There are two components to our perception of pain. These include the ________________ component which relays information from the dorsal column to the limbic system. The other is the ________________ pathway which relies on information exchange from the lateral thalamus to the somatosensory cortex.

5. The ascending spinal nociceptive pathways rely on the following neurotransmitters: (choose best answer)
   1. NE, GABA, TNF α, Calcitonin G related protein (CGRP)
   2. Substance P, Glutamate, CGRP, TNF α
   3. Serotonin, NE, Opiates, and GABA
   4. Substance P, Opiates, NE, Serotonin
   5. Serotonin, Glutamate, GABA, CGRP

6. All of the cells in the Spinothalamic tract project to the contralateral thalamus.  

TRUE or FALSE

7. The axons of the Spinothalamic tract project only to the VPL, VPM, VPI, VL, and LP nuclei of the Thalamus.  

TRUE or FALSE

8. The Spinothalamic tract helps to mediate the sensations of pain, cold, warmth and touch.  

TRUE or FALSE
9. The Cervicothalamic tract arises from neurons in the lateral cervical nucleus. The cervical nucleus receives input from Laminae III and IV. The axons travel to the ____________ side and ascend in the medial lemniscus of the brain stem to nuclei in the midbrain and to the VPL and VPM nuclei of the thalamus.

10. Most axons of the Spinomesencephalic tract originate from Laminae IV-VI as well as Laminae X and the ventral horn. Some of these neurons give off collaterals that end in the lateral thalamus. The axons project in the ____________ anterolateral quadrant of the spinal cord to the Mesencephalic reticular formation and periaqueductal gray matter (PAG) and via the Spinobrachial tract to the Parabrachial nuclei.

11. The PAG is a synaptic location for descending inhibitory fibers. TRUE or FALSE

12. The Spinoreticular tract is composed of axons from Laminae VII and VIII. These axons ascend in the ____________ anterolateral quadrant of the spinal cord and terminate in the reticular formation of the Medulla.

13. The Spinohypothlamic tract is comprised of axons from Laminae I, V, and VIII. It projects directly to the __________________ centers and is thought to activate what type of responses?

14. What is the role of the Postsynaptic Dorsal Column tract? What types of fibers innervate these axons?
15. There are a few descending inhibitory pathways which originate from the periventricular grey matter. What are the inhibitory neurotransmitters upon which these pathways rely on?

16. The Periaqueductal Gray (PAG) sends excitatory signals to the Locus Coeruleus (LC) in the Pons which in turn sends inhibitory signals to Laminae II, III, and IV in the dorsal columns. **TRUE or FALSE**

17. The cranial nerves responsible for carrying Parasympathetic fibers include CN-X, CN-IX, CN-V, and CN-II. **TRUE or FALSE**

18. The Trigeminal Ganglion is also referred to as the _______________ Ganglion. It resides in ________________ which contains CSF. This ganglion divides into three branches. The Ophthalmic branch exits via ________________, the Maxillary branch exits the ____________________, and the Mandibular branch exits ________________.

19. What are the contents of the Pterygopalatine fossa?
20. Match the cranial nerves to their function:

<table>
<thead>
<tr>
<th>Cranial Nerve</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>I- Olfactory</td>
<td>1. Motor to stylopharyngeus muscle, parasympathetic to parotid gland, visceral sensation from the carotid body, general sensation from posterior 1/3 of the tongue</td>
</tr>
<tr>
<td>II- Optic</td>
<td>2. Taste to anterior 2/3 of the tongue, parasympathetic supply to all glands of head except parotid</td>
</tr>
<tr>
<td>III- Oculomotor</td>
<td>3. Special sensory for balance, hearing</td>
</tr>
<tr>
<td>IV- Trochlear</td>
<td>4. Motor to pharynx and larynx, parasympathetic to all thoracic and abdominal viscera</td>
</tr>
<tr>
<td>V- Trigeminal</td>
<td>5. Motor to sternocleidomastoid and trapezius muscles</td>
</tr>
<tr>
<td>VI- Abducens</td>
<td>6. Special sensory smell</td>
</tr>
<tr>
<td>VII- Facial</td>
<td>7. Motor to lateral rectus</td>
</tr>
<tr>
<td>VIII- Vestibulocochlear</td>
<td>8. Motor to intrinsic and extrinsic muscles of tongue except the palatoglossus</td>
</tr>
<tr>
<td>IX- Glossopharyngeal</td>
<td>9. Special sensory vision</td>
</tr>
<tr>
<td>X- Vagus</td>
<td>10. Sensory from surface of head and neck to sinuses, meninges, and external tympanic membranes. Motor to muscles of mastication.</td>
</tr>
<tr>
<td>XI- Accessory</td>
<td>11. Motor to all extraocular muscles except superior oblique and lateral rectus (SO4-LR6)</td>
</tr>
<tr>
<td>XII- Hypoglossal</td>
<td>12. Motor to superior oblique muscle</td>
</tr>
</tbody>
</table>
21. Match the cranial nerve with the parasympathetic fibers it carries:

<table>
<thead>
<tr>
<th>Cranial Nerve</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN X (Vagus)</td>
<td>1. Pupil constriction, accommodation</td>
</tr>
<tr>
<td>CN IX (Glossopharyngeal)</td>
<td>2. Lacrimal gland, Mucosal glands of nose and palate, Submandibular and Sublingual glands</td>
</tr>
<tr>
<td>CN VII (Facial)</td>
<td>3. Parotid Gland</td>
</tr>
<tr>
<td>CN III (Oculomotor)</td>
<td>4. Heart, GI system</td>
</tr>
</tbody>
</table>
Anatomy of the Spine

1. Imaging considerations of the spine:
   a. MRI is good at looking at bone, while CT scans are good at looking at soft tissue.  **TRUE or FALSE**

   b. T1 weighted images are better for visualizing _________ which appear white on these type of images.  T2 weighted images are better at visualizing _______ which appear white on these type of images.

   c. T1 images are good at looking at the bony structure of the vertebrae.  **TRUE or FALSE**

   d. Under what circumstances would one utilize contrast?

   e. Myelography involves the injection of contrast into the intrathecal space.  What are some of the reasons one would use this type of study?
f. Discography has multiple components including volumetric, manometric, radiographic, and pain provocation (concordant or discordant).

i. Volumetric exam involves injecting contrast into a disk. The maximum volume that can be placed in a lumbar disk is _____, while a cervical disk can take ______.

ii. Manometric evaluation involves transduction of pressures with increased disk volume and is a very objective study.

   TRUE or FALSE

iii. What is concordant pain on discography and how is it different from discordant pain?

iv. List at least three complications that may occur with discography. Is it useful to administer antibiotics with this procedure?
2. Anatomy of the Cervical spine:
   a. The lower cervical segments from C3-C7 consist of a 5 joint complex. This complex is composed of one ______________, two ______________, and two uncovertebral joints of ______________.

   b. Fill in the blanks in the image below:

   c. In the cervical region the nerve roots exit below the given pedicle. Hence the C5 nerve root exits below the C5 pedicle.

   **TRUE or FALSE**
d. To view cervical facets on x-ray, a lateral view should be obtained. If one wishes to view the foramen, an oblique view should be obtained. Is this any different in the lumbar region and if so how?

e. Where does the median nerve lie in an AP view of the cervical spine? How about in the lateral view?

f. In the cervical region, each particular facet is innervated by the median nerve from the current level, and the level above. In the Lumbar region, each facet is only innervated by the median nerve from the current level. **TRUE or FALSE**

3. Anatomy of the Lumbar spine:
   a. The lumbar region consists of a 5 joint complex. In the lumbar region there are two uncovertebral joints of Luschka, one intervertebral disc, and two facet joints. **TRUE or FALSE**

   b. If there is a disk herniation at L4-L5 which nerve root will most likely be affected?
      a. L3
      b. L4
      c. L5
c. What type of disk herniations are more common and why?

4. Abnormal anatomy of the spine:
   a. The disk is made up of two components: the Annulus fibrosis and the Nucleus pulposus. Which of the following characteristics best describes the intervertebral disk? (choose the best answer)
      1. The Annulus fibrosis consists of concentric lamellar rings around the disk, the outer 1/3 of which is innervated.
      2. The Nucleus pulposus is primarily composed of fat.
      3. The intervertebral disks are vascular structures.
      4. Vertebral endplates are susceptible to fractures which can disrupt the vascular supply and cause micro-hemorrhage.
   b. Internal disk disruption can be diagnosed by __________________________. This is a painful medical condition, and is the earliest form of DDD marked by disk dehydration, loss of disk height, subchondral marrow changes, and an annular fissure.
c. Utilizing the relative amount of extrusion of the disk circumference, what is the difference between a generalized disk bulge and a focal herniation?

d. A disk protrusion is the same as a herniation and an extrusion. The difference is the extent to which the disk bulges into the epidural space. Which of the following four statements is true?

1. In an axial view, a disk protrusion has a larger y-axis span than x-axis extension.

2. A herniation has a small extension on the x-axis and a greater extension on the y-axis (its extending into the epidural space more).

3. A disk extrusion is simply a herniation that extends cranially and caudally. A disk extrusion is *not* in continuity with the disk.

4. A disk sequestration is an extrusion where the segment is in continuity with the disk.

e. Extrusions and sequestrations will enhance with contrast which is another reason to obtain a contrast study when there is a mass in the lateral recess. **TRUE or FALSE**
f. Spinal Stenosis, Lateral Recess Stenosis

i. Below are the three proposed etiologies of stenotic pain in an individual. Explain how each of these patients will present:

1. Arterial insufficiency:

2. Venous congestion:

3. Compression:

ii. Cervical spinal stenosis is associated with myelopathy whereas lumbar stenosis is not usually associated with myelopathy. Why?
iii. Indicate the motor neuron deficiency associated with each of the following signs:

<table>
<thead>
<tr>
<th>Sign</th>
<th>Upper or Lower Motor Neuron</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weakness</td>
<td></td>
</tr>
<tr>
<td>Fasciculation</td>
<td></td>
</tr>
<tr>
<td>Up-going plantar response</td>
<td></td>
</tr>
<tr>
<td>Atrophy</td>
<td></td>
</tr>
<tr>
<td>Hyperreflexia</td>
<td></td>
</tr>
<tr>
<td>Hyporeflexia</td>
<td></td>
</tr>
<tr>
<td>Spasticity</td>
<td></td>
</tr>
<tr>
<td>Flaccidity</td>
<td></td>
</tr>
</tbody>
</table>

5. Pathologic conditions of the spine:
   a. Vertebral bodies
      i. DISH syndrome (diffuse idiopathic skeletal hyperostosis)
         1. DISH syndrome is associated with pain and stiffness. It is non-radiating in nature. How is this disease diagnosed radiographically?

   2. How is this condition different from ankylosing spondylitis?
ii. Ossification of the Posterior Longitudinal Ligament (PLL)
   1. This condition can coexist with DISH.  
      **TRUE or FALSE**

   2. It can lead to LE symptoms and eventual bladder dysfunction.  
      **TRUE or FALSE**

iii. Ankylosing spondylitis is a spine calcification disorder. 
   Calcification of the annulus and the ligaments gives rise to the term ________________ which lacks flexibility and is susceptible to fractures.

b. Impingement upon spinal nerve roots
   i. Define and distinguish between Radiculopathy, Radicular pain, and Radiculitis:

   c. Disorder of alignment
   i. Define the following five types of Spondylolisthesis:
   1. Dysplastic
2. Spondylo-lytic

3. Degenerative

4. Traumatic

5. Pathologic

ii. How is the diagnosis of Spondylolisthesis made? Slippage greater than what distance would indicate an unstable spine requiring surgical intervention?

6. Spinal anatomy:
   a. The spine can be conceptually divided into three compartments; Anterior, Middle, and Posterior. The anterior compartment is innervated by _______________________. The middle compartment is innervated by ________________________ which make multiple connections at multiple levels of the spine. The posterior compartment is innervated by ____________________ of the dorsal ramus.
7. Treatment Paradigm:

   a. Considering the etiology, and the pathogenesis indicated below, fill in the possible treatments for each condition:

<table>
<thead>
<tr>
<th>Etiology</th>
<th>Pathogenesis</th>
<th>Rx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annular tear</td>
<td>Leak of mediators, altered mechanism</td>
<td></td>
</tr>
<tr>
<td>Protrusion, Herniation</td>
<td>Leak of mediators, compression</td>
<td></td>
</tr>
<tr>
<td>Facet and SI</td>
<td>Biomechanical</td>
<td></td>
</tr>
<tr>
<td>Failed Back Sx</td>
<td>Multiple</td>
<td></td>
</tr>
</tbody>
</table>

   b. Intradiscal Electrothermal Coagulation (IDET) can be used to cause contraction of collagen tissue, thermal denervation, and granulation tissue formation. Name at least three conditions which may warrant the use of this treatment technique:

   1. 
   2. 
   3. 
Anatomy of Thorax and Abdomen

1. Thorax:
   a. What is Tietze syndrome?
   b. The Phrenic nerve innervates the peripheral diaphragm.  
      **TRUE or FALSE**
   c. The mediastinal and the diaphragmatic pleura receive innervation from 
      the Phrenic nerve.  
      **TRUE or FALSE**
   d. Describe how the convergence-projection theory explains referred 
      pain.
2. Autonomic Nervous System:

a. The ANS as a whole is divided into a sympathetic and a parasympathetic system.  **TRUE or FALSE**

b. The sympathetic system ranges from T2-L2.  **TRUE or FALSE**

c. The sympathetic system is composed of short preganglionic and long postganglionic fibers.  **TRUE or FALSE**

d. The parasympathetic system involves cranial nerves X, IX, VII, III (1973) and S2-S4.  **TRUE or FALSE**

e. The parasympathetic system is composed of short preganglionic and long postganglionic fibers.  **TRUE or FALSE**

f. The sympathetic ANS preganglionic fibers travel to a para-vertebral sympathetic chain ganglion via WHITE rami where they synapse and exit as GRAY rami, ascend/descend the sympathetic chain, or they travel further to a Pre-vertebral ganglion.  **TRUE or FALSE**

g. The prevertebral ganglion includes the Celiac ganglia, the Aortic plexus, the Superior Hypogastric plexus, and the Inferior Hypogastric plexus.  **TRUE or FALSE**

h. The Splanchnic nerves are derived from T5-T12.  **TRUE or FALSE**
i. The Vagus nerve contains motor, somatic, visceral afferent and parasympathetic fibers.  
\[
\text{TRUE or FALSE} 
\]

j. Sacral roots S2-S4 send long preganglionic fibers to the pelvic splanchnic nerves and onto the pelvic inferior Hypogastric plexus.  
\[
\text{TRUE or FALSE} 
\]

k. The visceral afferent sensory system is a sympathetic system.  
\[
\text{TRUE or FALSE} 
\]

l. Autonomic efferent centers in the spinal cord include: (fill in the blanks)

1. Head and Neck ___________
2. Heart sympathetic ___________
3. Thoracic sympathetic ___________
4. Lungs sympathetic ___________
5. Abdominal sympathetic ___________
6. Pelvic parasympathetic ___________

3. ANS pharmacology and its relevance to neurotransmitter release at various ganglia:

   a. In the SNS the preganglionic neurons release Ach onto ___________ receptors in the sympathetic chain ganglion. Postganglionic neurons then release Noradrenaline onto ___________ receptors.

   b. In the PNS the postganglionic neurons release Ach which acts on ___________ receptors.
1. Please fill in the blanks in the image of the Brachial Plexus below. Also state which muscles are innervated by each of the nerves tested:

**Brachial Plexus**
a. Match the motor, reflex, and sensory function for each nerve:

<table>
<thead>
<tr>
<th>Nerve</th>
<th>Motor</th>
<th>Reflex</th>
<th>Sensation</th>
</tr>
</thead>
<tbody>
<tr>
<td>C5</td>
<td>Finger flexors, hand intrinsics</td>
<td>Biceps reflex</td>
<td>Medial forearm, med. Ant. Brach. Cutaneous nerve</td>
</tr>
<tr>
<td>C6</td>
<td>Hand intrinsics</td>
<td>Triceps reflex</td>
<td>Medial Arm, med. Brach. Cutaneous nerve</td>
</tr>
<tr>
<td>C7</td>
<td>Forearm pronation and supination, wrist extension and flexion.</td>
<td></td>
<td>Index and Middle finger, dorsum of hand</td>
</tr>
<tr>
<td>C8</td>
<td>Deltoid, Biceps</td>
<td>Brachioradialis reflex</td>
<td>Lateral aspect of forearm, thumb, and index finger</td>
</tr>
<tr>
<td>T1</td>
<td>Triceps extension, wrist flexion and extension, finger extension</td>
<td></td>
<td>Lateral arm, Axillary nerve, deltoid numbness</td>
</tr>
</tbody>
</table>

b. Match the major peripheral nerve with its motor and sensory function:

<table>
<thead>
<tr>
<th>Nerve</th>
<th>Motor</th>
<th>Sensation</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Radial (C6-8)</td>
<td>Deltoid</td>
<td>Lateral arm,</td>
</tr>
<tr>
<td>b. Ulnar (C8-T1)</td>
<td>Biceps</td>
<td>Lateral forearm</td>
</tr>
<tr>
<td>c. Median (C6-8,T1)</td>
<td>Wrist extension, thumb ext., triceps, brachialis, brachioradialis, supinator</td>
<td>Distal ulnar aspect, little finger</td>
</tr>
<tr>
<td>d. Axillary</td>
<td>Thumb pinch, opposition of thumb (ok sign), abduction of thumb, pronator</td>
<td>Dorsal web spaces between thumb and index finger</td>
</tr>
<tr>
<td>e. Musculocutaneous</td>
<td>Abduction, flexor hand muscles, little finger</td>
<td>Distal radial aspect, index finger</td>
</tr>
</tbody>
</table>
c. What is Tinel’s sign? What is Phalen’s sign? Why are they used?

d. DeQuervain’s syndrome occurs due to (choose the best answer):
   1. Inflammation of the abductor pollicis longus
   2. Inflammation of the abductor pollicis brevis
   3. Inflammation of the extensor pollicis brevis
   4. Inflammation of the extensor pollicis longus
   5. 1 and 3 are correct
   6. 2 and 4 are correct
   7. All are correct

2. Lower Extremity Anatomy:
3. Review the lower extremity dermatomes:

Levels of Principal Dermatomes:
- C5: Clavicles
- C6, C7, C8: Hand
- C8: Ring and Little fingers
- T4: Nipple line
- T6: Shoulder Blades
- T10: Umbilicus
- L4, L5, S1: Foot
- L4: Medial Side of Great Toe
- S1: Lateral Margin of Foot and Little Toe
- S2, S3, S4: Perineum
a. Foot drop occurs due to the compromise of which nerve root?

b. The Achilles reflex tests which nerve root function?

c. What is the “anal wink” sign? What does it demonstrate?

d. The Sciatic n. (L4-S3) innervates the hamstrings, muscles of the leg and foot, and it is sensory to the outer leg and the whole foot.

**TRUE or FALSE**

4. Match the major peripheral nerve with its motor, reflex, and sensory function:

<table>
<thead>
<tr>
<th>Nerve</th>
<th>Motor</th>
<th>Reflex</th>
<th>Sensation</th>
</tr>
</thead>
<tbody>
<tr>
<td>L4</td>
<td>_____ Extensor hallucis longus</td>
<td>_____ Achilles heel reflex</td>
<td>_____ Dorsum of the foot and lateral leg</td>
</tr>
<tr>
<td>L5</td>
<td>_____ Peroneus longus and brevis</td>
<td>_____ Knee reflex</td>
<td>_____ Lateral aspect of the ankle and foot</td>
</tr>
<tr>
<td>S1</td>
<td>_____ Tibialis anterior</td>
<td>_____ No reflex to check</td>
<td>_____ Medial aspect of foot</td>
</tr>
</tbody>
</table>

5. Fill in the blanks on the following pages, indicating the nerve(s) responsible for the indicated movement: