



Sectional Neuroanatomy of the Pelvic Floor

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Abstract

INTRODUCTION: An increasing number of chemical denervation procedures with Botulinum-A toxin as well as percutaneous interventional procedures such as a sacral or pudendal nerve stimulators and electromyographic studies are performed in the pelvic floor region for the evaluation and treatment of urinary incontinence, fecal incontinence, benign prostatic hypertrophy (BPH), and pelvic pain. Injections and stimulator electrode placement occur at many sites and do not correlate with routine EMG pin insertion sites.

OBJECTIVE: To provide anatomically accurate schematics of innervation of the pelvic floor with special attention to muscles and their innervation. These schematics can be used to increase the accuracy of EMG and minimize complications when performing chemical denervation and percutaneous procedures. They will also aid in interpreting MR images of the muscles and nerves of the pelvic floor region.

METHODS/RESULTS: Cross sectional schematics of the pelvic floor were drawn as they appear in imaging projections. The major nerves were clinically grouped into color-coded categories. The muscles and skin surfaces were labeled and assigned the color (or colors) of the appropriate nerves. Both male and female variants were included.

CONCLUSIONS: An organized comprehensive map of the motor innervation of the pelvic floor allows the physician to increase the accuracy, efficacy, and distribution of botulinum toxin for chemical denervation procedures. This map may also assist electromyographers in planning their studies to detect neuronal injury or patterns of muscular changes in correlation with MR images. Finally, planning of other percutaneous procedures such as stimulator placements are made easier with anatomical schematics that correlate to MRI images.

Introduction

This poster is structured to provide anatomically accurate functional schematics of the motor and sensory innervation of the pelvic floor. It also provides radiographically oriented cross sections through the pelvis to assist in directly identifying structures for both injection procedures and electromyography.

The pelvis floor is becoming an increasingly frequent site for therapeutic and diagnostic injections.

1) Those involving the muscles include diagnostic electromyography (EMG) of the anal sphincter for evaluation of fecal incontinence.

2) Chemical denervation (botulinum-A toxin) blocks for treatment of urinary incontinence, fecal incontinence, pelvic pain as well as BPH

3) Pudendal nerve and sacral nerve stimulators for treatment of pelvic pain and incontinence

4) Prior to performing all of these procedures, it is essential to accurately visualize the regional anatomy.

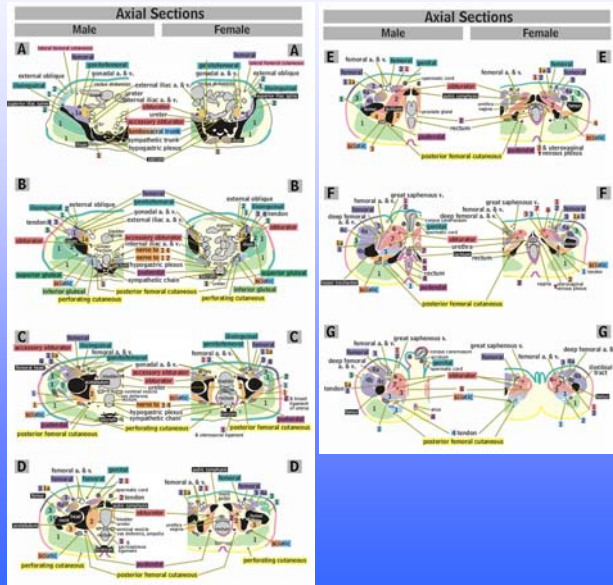
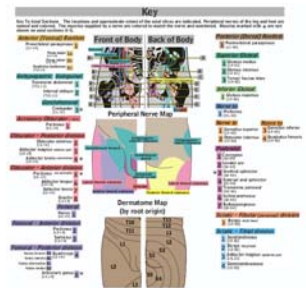
Methods

A review of the literature, anatomic references, and MR images of the pelvic floor were synthesized to provide the basis for the figures.

Cross-sectional schematics of the pelvic floor were drawn as they appear in imaging projections.

The major nerves were clinically grouped into twelve color-coded categories. The muscles and skin surfaces were labeled and assigned the color of the appropriate nerves.

The schematic summarized the most common pattern of root contributions to the various nerves. It should be kept in mind that there is considerable normal variation. Both male and female anatomy are included.



Discussion

1. The number of procedures in the pelvic floor has increased because of the advent of botulinum toxin injections.
2. The many botulinum toxin injections do not correlate with conventional EMG pin insertion sites. Therefore, a comprehensive anatomic chart is needed to provide accurate cross-sectional views of this important anatomy.
3. Injections are performed at several muscle sites to increase the distribution and efficacy of the drug. This approach reduces the total drug dose and the subsequent risk of antibody formation with resulting resistance to future treatments.
4. This anatomic reference is also useful in EMG procedures to guide muscle pin insertion sites in a part of the body not as familiar to electromyographers as the limbs and back.
5. This reference is also useful in procedures such as pudendal and sacral nerve stimulators.

Summary

In summary, this poster is the last in a series of articles detailing the neuromuscular anatomy of the limbs, face, and spine for interventional procedures. It synthesizes detailed anatomic and functional information concerning the pelvic floor. This information is needed to enhance the accuracy and efficacy of a variety of interventional procedures directed at the muscles, nerves, and vasculature of this region.