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Editor

Peripheral Nerve Entrapments

Clinical Diagnosis and Management

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This book is dedicated to my family, friends, and students, without whom I would never have had the strength to finish this work, and to my patients, who keep me motivated to find answers for their pain.

Andrea M. Trescot

Foreword

The contribution of Dr. Andrea M. Trescot and the multiple authors in the entrapment neuropathy field is very significant. These are topics that often are not covered at conferences, as the time limitations and program limitations exclude what appear to be minor areas. Ultimately, patients suffering from entrapment neuropathies are treated with inappropriate, alternative, excessive technological implants and/or heavy medications such as opioids and others. All these occur because the explanation of the problem, if you do not know it, does not exist.

There are multiple very significant and successful treatment recommendations covered in this book, including, for example, occipital neuralgia. Releasing the compression in the suboccipital compartment by the suboccipital decompression technique can very successfully treat migraine headache-type problems. Previously published and presently released results show that injecting the multiple nerves involved in the production of headache usually gives 2 weeks pain relief whereas the suboccipital decompression gives 24 weeks pain relief. Studies include a multitude of accurate and inaccurate diagnoses, but certain patients can experience years without recurrence of the occipital pain after a single suboccipital decompression from the inferior oblique muscle between C1 and C2, which is a considerable distance away from the superficial injections. In other words, if you know the mechanism of causation, then you are more likely to get long-term success.

The explanation for lower quadrant abdominal hypersensitivity is the entrapment of the iliohypogastric and ilioinguinal nerves going through three muscle layers (the external oblique, the internal oblique, and the transversus abdominis), before becoming cutaneous below the umbilicus. This condition often occurs in the second trimester of pregnancy, especially in muscular young mothers, where the growth of the baby stretches the abdominal musculature. This pain raises significant differential diagnostic problems, such as a misdiagnosis of acute appendicitis where surgical intervention may be hazardous and unnecessary at the same time. The treatment is simple, injecting along the iliac crest, popping through the external oblique aponeurosis and there is usually immediate pain relief; however, it may not last long enough. One can repeat the procedure or, alternatively, choose a longer-lasting solution such as cryoneurolysis in the same location, locating the nerve with the nerve stimulator at the tip of the cryo probe and freezing the nerve. The pain relief can be from 2 days to 1,000 days. Here, you see the diagnosis being made and appropriate treatment being carried out by short- and long-lasting therapeutic methods such as cryoneurolysis.

Another form of entrapment neuropathy that is often missed is saphenous nerve entrapment. The physician has to remember that the saphenous nerve comes off the femoral nerve and not only carries a sensory nerve to the inside ankle (medial malleolus) and the knee, but also it has significant sympathetic fibers. A saphenous block in Hunter's Canal, 4 in. above the knee, with a safe blunted Stealth™ needle, can relieve knee pain. This often helps regain mobility of knee joints, reduce swelling and discoloration of the foot and lower leg following long duration splinting and immobilization of ankle and knee joint. Here, the entrapment neuropathy comes from the extended disuse of the knee or ankle joint following immobilization after surgery or fractures. The resolution of the swelling comes from the lysis of the autonomic sympathetic fibers.

After upper extremity shoulder surgery and fractures, because of immobilization, one may see entrapment of the brachial plexus between the anterior and middle scalene muscles. Simple interscalene injection, however, can be performed with an occluded tip needle so that intraneural or intra-arterial injection should be less likely; even ultrasound guidance does not assure safety if open-ended sharp needles are used. There have been a considerable number of brachiopathies and cord injuries resulting in significant medical legal costs from the use of sharp needle injections in vascular regions where nerve and arteries travel together at the same injection site.

Using needles of too small a gauge can also be dangerous. Pneumothorax is one of the most common medical legal consequences of injections around the lungs; with small gauge needles, the needle can penetrating the lung multiple times, since small gauge needles have a mind of their own and do not go where the doctors wish they would go. The medical legal cost for a pneumothorax can be from zero to multiple six figures. In medicine, the principle must always be: *primum non nocere*, first do no harm.

Nerve entrapments can be caused by scarring anywhere along the path of the nerve, and the "lysis of adhesions" concept extends to scar tissues, where tendons may be limited by scarring and bleeding. Scarring also causes severe neuropathy in the spinal canal. Solving one source of neuropathic pain does not necessarily solve all pains and the doctor needs to remain vigilant by not just asking the question, "How is your pain?" but also examining the patient. It is surprising how many times the patient does not know where the pain is coming from.

I believe Dr. Trescot's recognition for the need to collect the subject matter in this book and subsequent assemblage of its contents is truly remarkable. It has been my pleasure to know and respect the work of Dr. Trescot; my reverence for her work originates in her realization of the need to expand our horizon and treat the patients appropriately rather than excessively. I feel the examples that I listed served to emphasize that not only does one need to recognize problems, but also solve problems with long-term results in mind. Alternatively, the short-term pain pill that may appear to work for hours will become a long-term issue by leading to addiction, chronic pain, and loss of work. All of this starts with the premise, "If you don't know it, it doesn't exist," which is not in the best interest of the patient or doctor. In conclusion, Dr. Trescot deserves all the accolades for exercising a tremendous effort to bring such valuable and extensive information to all of us.

Dallas, TX, USA Gabor Racz, MD, FIPP

Preface

Peripheral nerve entrapments are a commonly overlooked cause of painful conditions, resulting in pain literally from the head to the toe. Even the astute clinician may not be aware of these syndromes, and entrapment of these often small nerves can lead to debilitating pain, mimicking "migraines," cardiac disease, intra-abdominal pathology, "endometriosis," complex regional pain syndrome (CRPS), and "plantar fasciitis." Knowledge of these entrapments can prevent expensive ineffective testing and treatment and can ideally avoid unnecessary pain and suffering.

This book is a culmination of many years of my personal clinical observations as well as collaboration between many providers. Over the years, when I would lecture on peripheral nerve entrapments, I would be met with blank stares, or worse, derision. However, this lack of knowledge is slowly changing. Fifteen years ago, when I would ask the audience to raise their hand if they had ever even heard of the cluneal nerve, perhaps two or three hands would go up. Now, with the same question, sometimes a majority of the room will raise their hands.

There is suddenly a plethora of articles in the literature regarding peripheral nerve entrapment diagnosis and treatment, and the emergence of ultrasound-guided injections in pain medicine has confirmed some of the mechanisms, while at the same time elucidated new mechanisms of entrapment. One of the hardest parts of writing this book has been the decision to stop adding new information to the chapters, since every time that I would find a new reference, my developmental editor (Connie Walsh) would have to reformat the chapter.

This book has been designed to be a guide as well as a reference. We chose pain pattern images that will hopefully trigger the clinician to think about peripheral nerve entrapment as a cause of their patient's pain, while at the same time providing the scholarly anatomic descriptions of the nerve. We hope that this book will help you diagnose as well as treat your patients, using physical exam, differential diagnosis, medications, injections (landmark-guided, fluoroscopic-guided, and ultrasound-guided), neurolytics, neuromodulation, and surgery. Videos showing the physical exam and landmark-guided injections are included for most of the described nerves. We have also created an Index of Symptoms, so that a patient who is complaining of an "ice pick in my eye" should lead you to consider the greater occipital nerve as a possible etiology.

I hope that you will find this book useful to help the patient who is asking "who will stop the pain?"

Anchorage, AK, USA — Andrea M. Trescot, MD, ABIPP, FIPP

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A book of this size and scope is never created in isolation. Many thanks (and perhaps blame) go to Dr. Peter Staats, who 3 years ago sent *Springer Publishing* to talk to me about doing this book. Thanks also go to Connie Walsh (my developmental editor) and especially Joanna Perry (my original supervising editor), who talked me out of my panic half way through this project. When Joanna left Springer to pursue an MBA, she handed me over to Becky Amos, who shepherded this book to its final form.

I would like to thank my dear friend and collaborator, Dr. Helen (Ellie) Karl, who saw efficacy of these treatments and has become a "true believer." She has been the engine and organizer of this monumental project, and this book would have faltered and failed without her help. She checked and challenged every statement and image, so that this book would be as accurate as possible.

To my section editors, I give special thanks for their flexibility and trust, as the format and even the selection of nerves changed over the course of the development of this book. Each chapter author is a friend (or a friend of a friend), a fellow pain provider, and an advocate for recognition of these clinical syndromes. Many are mentees who were taught by me and who are now becoming the experts. Although each nerve chapter has an author's name attached, we have used a collaborative approach, with contributions by multiple authors, most unnamed, along the lines of Wikipedia. A few, however, deserve special recognition.

Drs. Dan Krashin and Natalia Murinova, an extraordinary husband/wife team (he is a psychiatrist and interventional pain physician, and she is a well-respected neurologist and migraine specialist), not only wrote their own chapters, but also wrote and rewrote many of the other chapters, some of which have their names on them and others that do not. In the same way, Dr. Michael Brown (interventional physiatrist) and Dr. Beth Pearce (podiatrist) provided a special expertise regarding pathologies of the lower extremities.

Dr. Thais Vanetti of Brazil and Dr. Tiffany Zhang of Seattle both did a wonderful job of editing many of my "problem" chapters, all the more amazing because English is their second language. Dr. Terri Dallas Prunskis jumped in to help me finish chapters as the final deadline approached and painted her family and staff to provide many of the nerve pattern pictures. Dr. Eric Wilson from South Africa helped to create the index of symptoms. My sister Leigh Trescot Tobias spent hours helping me to reformat the book when I had the "bright idea" to change the entire format after the book was three-quarters of the way done.

Dr. Agnes Stogicza, my "daughter" and (according to my husband) "mini-me," spent hours helping me by dissecting cadavers as well as creating US images of nerves as we traced nerves to their site of entrapment. Many of these US techniques have never been described in the literature, so expect a flurry of articles to follow the publishing of this book. She arranged for access to fresh cadavers in Hungary, as well as a wonderful anatomist, Gabor Balsa, who patiently and skillfully helped us to isolate nerves. We ultrasounded each other to trace nerves, and Agi always asked the tough questions of "why?" and "how?" and "what about this?" Her enthusiasm for pain treatment and new knowledge has kept me motivated.

Drs. Thiago Nouer Frederico and Fernando Mauad, from Brazil, and Drs. Michael Brown and Brian Shilpe, from the United States, generously provided many ultrasound pictures of the nerves. Thiago patiently traced nerves for me with ultrasound, showing potential entrapment sites not yet well described. Dr. Michael ("Micha") Sommer from the Netherlands reviewed nearly every image and provided valuable insight regarding the ultrasound and non-ultrasound images as well reviewing the "readability" of the language. Dr. Christ Declerck from Belgium also shared a variety of intriguing images. David Spinner, DO, contributed his ultrasound images of the supraorbital, infraorbital, and mental nerves, while Drs. Gladstone McDowell and Porter McRoberts donated several peripheral stimulator images. Holly Long, editor of the journal *Pain Physician*, graciously provided pictures and permissions from the American Society of Interventional Pain Physicians (ASIPP) textbooks and articles.

Accuracy is critical in a book such as this, and I had help from Dr. J. David Prologo (an interventional radiologist) who reviewed the MR images that I created and from Dr. Micha Sommer who reviewed the US images. Dr. Rubina Ahmad also helped to review images.

Over a dinner conversation during a conference in Poland, Ben Zylicz, MD, provided insight into the use of peripheral nerve injections in the treatment of cancer pain and agreed to put these thoughts down in a chapter. Heather Tick, MD, provided a balanced, integrated view of the non-interventional approach to these entrapments.

Edit Debreczeni, daughter of my friend Dr. Edit Racz of Hungary, volunteered on short notice to be my model for the videos of examination and injection that accompanies this book. Tamara Brothers, PA-C, Dr. Thais Vanetti, Dr. Joshua Balch, and my sister Caroline Kirkland also served as willing models. And my brother, David Trescot, volunteered his skills as a photographer and videographer/video editor to create almost every image in this book and to edit the raw video into the educational clips available here.

I would like to give special thanks to my children, Nicole and Joseph Gear, who were indispensible assistants, serving as models as well as copy editors. They allowed me to draw on and poke and scan their bodies to create just the right image, and then corrected my grammar and syntax. Nicole, especially, spent multiple sessions posing for images, and the images of her (I hope) have helped to unify the book; she also spend countless hours reviewing every word of the book to make sure that the information made sense. And this book would never have been possible without my loving, supportive, and long-suffering husband, Harold Gear, who even offered to let me inject him, just so I could get a better image for the book.

A final thanks goes to the support and encouragement over the years from students and colleagues, who would come up to me after my lecture to ask – "Where can I find a book with all this information?" Hopefully, this book will now answer that question.

Andrea M. Trescot, MD
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The plastinated human specimens shown in this book were produced by Prof. Dr. Hong-Jin Sui, Director of Dalian Medical University, China and Dalian Hoffen Bio-Technique Co,. Ltd, China, and are used here with their permission. The author wishes to thank Dr. Sui and Dalian Hoffen Bio-Technique Co., Ltd., for permission to use the photographs of these specimens.

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