Pain-Relieving Procedures
We dedicate this book to our wives, Nilgün Erdine and Susan Raj.
Pain-Relieving Procedures

The Illustrated Guide

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Interventional pain medicine is a relatively new specialty, with neurosurgeons and anesthesiologists as “founding fathers”. Dr Sam Lipton, Dr Norman Shealy, Dr Menno Sluijter, and Dr Prithvi Raj were, with many others, pioneers of interventional pain medicine at the beginning of the 1980s. After a short period of empirical use of interventional pain techniques, the procedures have been improved and are now more target specific. Nowadays, interventional pain management techniques have become accepted and integrated into the treatment of patients with chronic pain problems. In many treatment plans of patients with chronic benign pain problems such as chronic cervical or lumbar low back pain, interventional pain procedures are now an accepted solution. The same is true for problems caused by cancer pain such as that due to pancreas carcinoma or lung cancer.

Since the beginning of the 2000s we have been entering the second phase of interventional pain medicine: “the episode of further professionalization.” The public expect something from an interventional pain doctor nowadays: optimal medical knowledge, optimal patient care, technical skills, continuous practical-based learning, and professionalism. Pain physicians have to apply diagnostic and therapeutic interventions in the correct and safe way for the right clinical diagnosis. The clinical diagnoses in which these procedures can be applied were published in the evidence-based medicine series in *Pain Practice* in 2009/2011.

This book has been produced by the pioneer of interventional pain management Professor Dr Prithvi Raj and the key opinion leader of interventional pain at this moment Professor Dr Sedar Erdine. It covers all the relevant specific techniques of interventional pain medicine in an explicit way. More than 40 interventional procedures in and around the head, neck, thoracic, thoraco-abdominal, lumbar, and sacral regions are described.

Moreover, all the chapters are accompanied by detailed anatomical observations and the background to these procedures. This book is an important step in the further evaluation of interventional pain as a tool in the optimal treatment of patients with acute and chronic pain. It will also further improve the technical skills and the knowledge of all pain physicians.

Professor Dr Maarten van Kleef

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Pain science and pain medicine are relatively new specialties. The British Pain Society first met in 1971 and the International Association for the Study of Pain (IASP) organized its first international symposium on pain in 1973. Professor John Bonica and his colleagues established this large, multidisciplinary world society and developed the Journal of Pain. There have been meetings every 3 years until recently, when the frequency was changed to every 2 years.

Since the early 1970s many other groups have evolved, including the World Society of Pain Clinicians, the World Institute of Pain, and the European Federation of IASP Chapters (EFIC).

Before and during the past 40 years many specialists and general practitioners have treated pain, but not in any particularly organized manner. Acute pain was generally managed reasonably well, but there were clearly difficulties in understanding the causes of, and comprehensively treating, chronic pain. Physicians used drugs whereas physiotherapists and chiropractors used manipulations and physical therapy. Anesthetists were interested in perioperative and postoperative pain relief and their interest in regional blocks evolved into interventional management of more chronic forms of pain.

Bonica stressed the importance of multidisciplinary teams, with several different specialties working together. He knew that no one single therapist or specialist could muster all of the necessary knowledge to assess and treat patients comprehensively, and we all agree with this view.

Pain is complex, multidimensional, and can be very difficult to treat. The biopsychosocial model described by Engel at the University of Rochester, and first discussed in Science in 1977, has been widely espoused for the management of chronic pain. However it is regrettable that some practitioners have forgotten the importance of assessing each individual patient for the “bio-” part of the model: that is, identifying the specific pathological causes (both nociceptive and neuropathic) for the chronic pain problem, which can sometimes be addressed and successfully treated.

Anesthetists and neurosurgeons started by trial and error, trying different types of procedure for different types of patient, empirically, and just seeing what worked. In the early days at the Walton Centre, Sam Lipton used percutaneous cordotomy for many patients with unilateral pain. We rapidly discovered that patients who had a normal life expectancy often developed dysesthesia and bothersome neuropathic pain within a few months, which was more troublesome than the original problem, so cordotomy became a treatment for those with only a short-term life expectancy.

As time has passed, the development of evidence-based medicine has meant careful evaluation of medication in large, randomized controlled trials with many patients. Interventions for pain relief have come under attack because of a lack of scientific evidence to prove efficacy. There are still too many procedures being performed – some on empirical grounds without there being much hope of them working, others because that is the way the practitioner was taught, and others done by doctors without the adequate training and knowledge to achieve a successful outcome.

Failed interventions because of faulty technique are simply unacceptable. Performing the wrong technique on the wrong patient is also unacceptable. This type of behavior by untrained, inadequately trained specialists puts the future of interventional procedures in pain medicine in jeopardy.

To ensure the future of interventional procedures and to secure the place of anesthetists in the management of chronic pain, it is essential that we use evidence-based principles where these exist. We need to have a thorough understanding of the assessment of the patient (both from the physical and psychological point of view), the anatomy, and the physics behind the treatments we use.

This book addresses these important issues. Packed with wonderful illustrations, it describes basic principles of interventional techniques, physical and psychological assessment of the patient, preparation of the patient for treatment, and monitoring during and after therapy. It discusses radiation safety and the importance of imaging, including fluoroscopy and ultrasound. The various different methods of intervention are described, including use of local anesthetics and neurolytic agents, steroids, and the different forms of radio frequency.

It goes on to describe in detail the various different types of procedure that might be performed, in a full and
comprehensive manner. In all, there are 18 chapters and over 50 techniques are described.

There are three types of illustration. There are pictures of patients, separate three-dimensional computed tomography scans, and fluoroscopic pictures for each technique, showing each procedure step by step.

The authors know their subject thoroughly, not only from extensive knowledge of the literature and research but most importantly the practical aspect of performing these procedures over many years and on many patients. They have been key figures in many of the international groups mentioned, and have published and taught extensively over decades. The reader will gain a constructive and effective knowledge of the many procedures that can be used to aid chronic pain sufferers. In particular, this is an important guide for those who wish to get a higher degree in the subject of pain management and the Fellowship of Interventional Pain Practice (FIPP).

Dr J. C. D. Wells
President Elect, EFIC
Preface

There is consensus in the pain management community that the practice of pain management has now become a specialty on its own and requires careful nurturing of its growth, training of pain physicians, and the creation of acceptable standards of practice guidelines for the physicians.

This complex task, to define standards of pain practice, is extremely difficult and differs among all the specialists who manage patients with pain in their professional practice. For instance, if one asks the anesthesiologist to describe their plan of pain management, they would invariably describe the performance of regional anesthesia techniques as their primary requirement, with a secondary requirement of pharmacotherapeutics, psychiatric modalities, and functional restoration algorithms. This concept is almost always challenged by psychiatrists, physiatrists, neurologists, and even neurosurgeons.

Whichever direction this debate takes us in the standards of pain practice, it is absolutely necessary that all specialties should agree a multidisciplinary approach is essential. This multidisciplinary approach should consist of knowledge of anatomy and physiology of pain mechanisms, knowledge of pain syndromes, diagnosis and management by conventional methods, and, when necessary, use of interventional techniques including minimal invasive surgery.

Although there are now a multitude of text books on the management of pain, publications of specialized techniques in pain management are still few and far between. This is certainly true of the books pertaining to interventional pain procedures. In the past decade, radiographic imaging techniques in pain management have been published; these include two editions by Raj et al., Rathmel, and Waldman. They have been accepted as valuable books for the study and training of interventional pain physicians.

Interventional pain procedures are now evolving, increasing in their complexities; strict protocols are now required to maintain the standards of practice. Fellowship certification for interventional pain physicians is provided by an examination globally by the World Institute of Pain and by the American Board of Interventional Pain Physicians for US candidates. Physicians who are eligible to take the examination have to show training in interventional procedures in a curriculum acceptable to governing agencies.

_Pain-Relieving Procedures: The Illustrated Guide_ is conceived to fill a void in the existing literature. It is an illustrative guide for all currently performed interventional procedures as approved by the experts in the field.

We conceived to present this book to the reader as a step-by-step guide to perform all interventional techniques in an easily understood, simple style. It took 3 years to complete and contains over 1000 figures.

The chapters are divided in two sections. The first is the general section, where the essential basic knowledge for interventional pain physicians is provided. The second section describes all commonly performed techniques, arranged simply and topographically from head to pelvis. To cover all procedures, a special chapter is provided for specialized techniques, such as continuous analgesia, spinal cord and sacral stimulation, vertebroplasty, and kyphoplasty. Modalities of radiofrequency and ultrasonography are presented wherever indicated, along with their basics of physics and mechanisms.

The chapters are straightforward and simply written, to inform basic and essential knowledge about the general requirements for interventional pain physicians and to provide steps to learn the techniques in a standardized manner. The strength of this book is the preparation of the figures, which are outstanding. The uses of three-dimensional computed tomography anatomical images presented in color are unique and easy to understand. The authors reviewed figures from experts all over the world who could enhance the quality of the book by their original publications. We are indebted to Professor J. Taylor from Western Australia for his exceptionally unique figures depicting the various regions of spinal anatomy in full color. Similarly, we thank James Heavner for his epiduroscopy figures, and Sang Chul Lee for his ultrasonography pictures.

The format of the chapters is uniformly written under the headings of history, anatomy, indication, contraindication, technique, complications, and helpful hints. Chapters do not cite references in the text; however, conveniently, a further reading section is provided at the end of each chapter. We believe that we have achieved the objectives set out by the publisher: to provide an illustrated guide to interventional procedures in a clear, simple step-by-step instruction to the physician who wishes to perform the chosen procedure.
current standard of practice is always kept in mind. We hope that the reader will find this book easy to read and learn from when they train to be specialists in interventional pain practice.

Finally, there is still a disparity between education and training of pain physicians all over the world for interventional pain practice. The publication of this book is a small attempt to minimize this discrepancy. There should be standardized guidelines for interventional pain practitioners.

We hope this book will help physicians set appropriate guidelines. Guidelines need to be established based on best evidence and clinical experience, and should be periodically reviewed. We also hope that pain fellowship programs will make this book part of their curricula for interventional pain procedures.

P. Prithvi Raj
Serdar Erdine
Acknowledgments

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We thank Bill Naughton; the graphics designer who collated and formatted over 1000 figures with great expertise and finalized the figures to conform with the publisher’s guidelines.

Finally, we thank Susan Raj for being a coordinator for this book; her efforts in triaging the various materials that moved between the authors at two locations and the graphics designer were outstanding.
1 General Principles
1

History of Interventional Pain Medicine

Formative years

The contemporary era in pain management really began with the discovery of nitrous oxide and its analgesic properties in the late 18th century. This was soon followed by scientific investigation of the anesthetic properties of nitrous oxide and ether on animals, and the use of these substances in human patients. Surgical anesthesia was first publicly demonstrated at Massachusetts General Hospital in 1845 and 1846. The discovery and use of anesthetics changed the perception of pain (Fig. 1.1). In the 1850s Charles Gabriel Pravaz, a French surgeon, and Alexander Wood of Edinburgh independently invented the syringe (Fig. 1.2a,b), which allowed injections of morphine. By the 1860s the efficacy of locally applied opiates, especially morphine, directly to the skin or nerves for pain relief was widely accepted. The effects of pre- and intraoperative administration of morphine to the area of incision or amputation were investigated. When cocaine became available as a local anesthetic, owing to the work of Sigmund Freud and, especially, Karl Koller, this soon resulted in its use as a local anesthetic in diverse procedures (Fig. 1.3a,b).

Surgical techniques for pain relief represented another great medical advance during the 19th century. With the advent of antiseptic surgery, procedures became less life threatening, allowing investigation of pain relief techniques involving permanent interruption of afferent pathways. Innovative techniques were developed for treating trigeminal neuralgia, in addition to procedures such as retrogasserian neurectomy and cordotomy, ablation of the sympathetic nervous system, sympathectomy for visceral pain and angina pectoris, and surgical management of neuralgia.

Pain mechanisms

Little was understood about pain mechanisms at the beginning of the 19th century. Many questions such as how sensibility related to movement, whether separate sensory and motor nerves existed, and whether single nerves could perform different functions were still unanswered. Early researchers tried to explain pain by concentrating on the specialization of functions in different parts of the brain. Animal experiments investigating the function of spinal nerve roots were more successful, significantly contributing to medical knowledge during this period. Investigators such as Claude Bernard, Charles Bell, and Francois Magendie developed innovative experimental procedures that allowed differentiation of sensation from movement and between functions of anterior and posterior spinal nerve roots. A significant impetus to the perception of the nervous system as a system involving the transmission of sensations from the periphery to the center through a system of complex relays was provided by the work of German physiologist and comparative anatomist Johannes Muller (Fig. 1.4).

Muller proposed a connection between the anatomic pathway of a fiber and perception of sensation, stimulating further research on specific fibers for pain and nociception. As a result of such work, an entirely new school of physiologic research was founded. Soon nerve structures were identified in the dermis, leading to investigation of dissociation of sensations in that region, such as sensation of touch, pressure, and pain; and the spinal cord was more realistically appraised as a central processor with the ability itself to affect the transmission of sensations. Other noteworthy contributions were made by Waller, who developed a sectioning technique allowing observation of fatty degeneration of a fiber, leading to an awareness of ascending and descending pathways and the origin of nerve fibers.

There were many other pioneers who, through work with patients in pain or self-experimentation, contributed to the general body of medical knowledge: Weir Mitchell’s work with neuritis, neuralgia, and causalgia, Henry Head’s discovery of two different types of nerve fiber, and Sherrington’s notion of an integrated nervous system were major advances establishing a firm foundation for an understanding of pain.

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mechanisms and more effective approaches to treatment (Fig. 1.5).

We are indebted to Melzack and Wall for perhaps the most significant leap in understanding, the gate control theory. This explanation located both facilitators and inhibitory influences on the cells of the substantia gelatinosa of the spinal cord; with large-diameter, fast-conducting touch fibers suppressing, and smaller-diameter, slower-conducting pain fibers increasing, central output. Because nerve lesions usually involve smaller fibers, they result in over-activity of the substantia gelatinosa. Scar formation at the site of nerve injury causes complications, increasing nerve excitability at the site of the lesion (Fig. 1.6).

**Figure 1.1** The first surgical anesthesia in Massachusetts General Hospital in 1845.

**Figure 1.2** (a) Gabriel Pravaz, courtesy of Wellcome Library, London. (b) Alexander Wood, reproduced with permission from Peter Stubbs (www.edinphoto.org.uk).

**Figure 1.3** (a) Sigmund Freud, (b) Karl Koller (courtesy of the Wood Library Museum of Anesthesiology, Park Ridge, IL, USA).
fibers, which causes central inhibition of pain signals. Dorsal column stimulators are now an effective means of treating patients with chronic neuropathic and vascular pain. In addition, peripheral nerve stimulators have been used to manage chronic pain after peripheral nerve injury. Deep brain stimulation is a newer technique, still somewhat uncertain in terms of efficacy of pain relief.

New treatment techniques represent another beneficial byproduct of pain-related research. For instance, the discovery of opioid receptors in the central nervous system provided a rationale for the development of intrathecal and epidural administration of opioids. These now active techniques have resulted in the formation of a new sub-specialty under the umbrella of primary specialists of pain medicine. This sub-specialty has been called interventional pain medicine.

Biotechnology allows drugs targeted towards specific physiological processes to be developed, sometimes designed for compatibility with the body to reduce side effects. Genomics and knowledge of human genetics is having some influence on medicine, as the causative genes of most monogenic disorders have now been identified. In addition, the development of techniques in molecular biology and genetics is influencing medical technology, practice, and decision-making.

Establishment of interventional pain medicine

Greater understanding of pain mechanisms has resulted in the development of devices offering innovative therapeutic approaches. For instance, dorsal column stimulators were a direct result of the gate control theory. The efficacy of treatment relies on stimulation of low-threshold primary afferent fibers, which causes central inhibition of pain signals. Dorsal column stimulators are now an effective means of treating patients with chronic neuropathic and vascular pain. In addition, peripheral nerve stimulators have been used to manage chronic pain after peripheral nerve injury. Deep brain stimulation is a newer technique, still somewhat uncertain in terms of efficacy of pain relief.

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Evidence-based medicine is a contemporary movement to establish the most effective algorithms of practice through the use of systematic reviews and meta-analysis. The movement is facilitated by modern global information science, which allows all evidence to be collected and analyzed according to standard protocols, which are then disseminated to healthcare providers. One problem with this “best
practice” approach is that it could be seen to stifle novel approaches to treatment. The Cochrane Collaboration leads this movement.

Defining a pain specialist

John Bonica was the first anesthesiologist who experienced the difficulties of pain management during his years in the army as he was treating the wounded soldiers from the Pacific. He felt strongly that no one particular physician is capable of looking after a patient with pain. He proposed the first concept of multidisciplinary approach to pain management.

What defines a “pain specialist?” Rollin Gallagher stated, “specialties define themselves [in] many ways: by age group (pediatrics), organ system (cardiology), specific constellation of illnesses or diseases (infectious diseases), type of procedure (surgery), or practice setting (emergency medicine).” Held to this definition, pain management becomes a unique specialty indeed. Although pain management is concerned with the diagnosis, treatment, and rehabilitation of a singular sensory symptom, it is essential that practitioners undertake a multidisciplinary approach to achieve these ends. They must also be well versed in the study of pain and its prevention. Although more than 60% of pain specialists originate from the field of anesthesiology, they can also come from a variety of other disciplines such as interventional radiology, physical therapy, psychiatry, primary care medicine, and neurology. In addition, pain specialists must possess a keen understanding of the variety of conditions and causes associated with pain. This broad range of training and knowledge allows the practitioner to achieve their ultimate goal: the management of a patient’s pain. Despite these extensive requirements, pain management remains classified as only a subspecialty of anesthesiology under the certification of the American Board of Anesthesiology (ABA) in the United States. The American Academy of Algology in 1983, now the American Academy of Pain Medicine (AAPM), has strived to create a separate specialty of pain medicine, but without success so far.

Competency and certification of pain physicians

Effective pain management requires that physicians take a multidisciplinary approach to their evaluation, diagnosis, treatment, and rehabilitation of pain problems. They must not only draw from several medical disciplines, but must also understand the complex nature of pain. This distinction makes pain medicine a unique specialty compared with more specific medical fields such as cardiology and pediatrics. Even so, pain medicine continues to develop gradually as a specialty in North America and Western Europe, with other countries being left behind.

However, because pain practitioners are required to possess such a broad skill set, medical schools have found it difficult to develop effective curricula and credentialing methods for this subspecialty. The inadequacy of education in pain management can, and has, led to the poor treatment of pain disorders, especially those of a chronic nature. Although the link between inadequate education and improper treatment is well understood, studies suggest that disparities in pain education continue to exist.

The current problem in educating a pain specialist is, therefore, a two-fold issue. First, the existing pain medicine education disparity must be addressed. The development of effective and relevant curricula will provide future pain specialists with adequate training. Second, in addition to curriculum development, the program must have a thorough and integral assessment method to determine competency properly. Credentialing is vital for upholding precise standards within pain medicine.

Several organizations, such as the American Board of Anesthesiology, the American Academy of Pain Medicine, and the World Institute of Pain, have begun to address the disparity and credentialing issues.

Education and training of interventional pain physicians

With increasing recognition of pain management as a specialty, there is early development and formalization of curricula and training programs. Noteworthy among accomplishments in this area are development by the American Board of Anesthesiology of a course of training in pain for anesthesiology residents, formulation of guidelines by the Accreditation Council for Graduate Medical Education for the approval of pain fellowship programs, and the establishment of a core curriculum for the study of pain by the International Association for the Study of Pain (IASP). Postgraduate fellowship training programs are now widely available. The American Board of Anesthesiology certifies anesthesiologists, physiatrists, and neurologists for added qualification in pain management after they have taken their pain management certification examination. The American Board of Pain Medicine certifies physicians of all specialties when they take a written examination. Similar action has also been taken in the United Kingdom and is spreading to other countries such as the Netherlands, Australia, and Turkey. In addition, the study of pain has altered the way many physicians manage their patients, increasing awareness of opportunities for alleviating pain and the necessity of early intervention.
Present status of interventional pain medicine

Can we, today, looking back over history, state that we have finally conquered pain? The answer has to be the following: in some ways, yes; in some ways, no. We have certainly conquered surgical pain, the pain of childbirth, and perhaps pain due to trauma. Unfortunately, we have not progressed a great deal in the areas of chronic and cancer pain.

Chronic pain remains a taxing and frustrating situation for both the patient and the clinician. Despite our concern and advanced knowledge, we are still unable to help the patient who comes to us with increasing pain, decreased function, and debilitating psychological difficulties, such as feelings of low self-worth, depression, and inability to cope.

One should emphasize the importance of pain management, its advances as a discipline, and the options we now have available to treat a patient with moderate-to-severe pain. The discovery of opioid receptors, a taxonomy of classification of pain, a multidisciplinary and multimodal treatment approach, and the establishment of curricula and training are spectacular advances in pain medicine. It is not surprising, therefore, that these advances have contributed significantly to the practice of medicine.

Pain societies and education

Over the past few decades, several organizations have been created, with the primary purpose of expanding pain management education in the United States and the world. These organizations include the following.

- The American Society of Regional Anesthesiology and Pain Medicine (ASRA). Organized in 1976, the ASRA is an affiliation of anesthesiologists and other physicians who have strived to advance scientific knowledge through education about and research of regional anesthesia. Pain control has become a major area of interest of the society.
- The International Association for the Study of Pain (IASP). Founded in 1973, the IASP has become the largest multidisciplinary international association in the field of pain. Its purpose is to encourage pain research, promote education, facilitate the exchange of information, encourage education of the public regarding pain issues, encourage the development of a data bank, and to advise political agencies on standards of pain treatment.
- The World Institute of Pain (WIP). With the development of pain medicine into a subspecialty, it was recognized that links between the international pain centers also needed to be developed. The WIP was created to accomplish this goal. In addition to this mission, the WIP strives to educate and train personnel of member pain centers, develop common protocols for efficacy and outcome studies, categorize and credential pain centers, and develop examination processes for pain centers in testing trainees.

Credentialing

Even if medical schools adopt and maintain effective pain management curricula, the establishment of clinical reliability for pain specialists is only half-complete. There remains the essential task of credentialing. An effective and objective system for determining competency must also be developed.

The World Institute of Pain

The Fellow of Interventional Pain Practice (FIPP) Examination Board provides an examination in interventional techniques and attempts to establish clinical competency further in interventional pain practice. Eligibility for the certification examination requires the following:

- licensure;
- completion of a 4-year Accreditation Council for Graduate Medical Education (ACGME)-approved residency (or equivalent), that included pain management;
- American Board of Medical Specialties board certification or equivalent;
- a minimum of 24 months of clinical practice experience in pain medicine; and
- upon certification, strict adherence to ethical and professional standards set by the WIP and its Section of Pain Practice.

The Examination in Interventional Techniques consists of three sections: theoretical examination, practical examination, and oral examination.

Although certification programs do recognize accepted levels of knowledge and expertise in pain management, it is generally agreed that they cannot guarantee competence or successful treatment of the patient to the public. Nor can they guarantee that certification examinations will properly reflect state-of-the-art knowledge and procedures, owing to the rapid changes in the field of pain medicine. However, these certification programs strive to establish clinical reliability for a specialty that requires advanced training, experience, and knowledge.

Conclusion

A review of the history of pain demonstrates that until the time of Bonica, pain management was considered to be unimodal, unidisciplinary, and managed without any clear structural organization. Today, new drugs and creative techniques and procedures have expanded the scope of pain medicine into a multidisciplinary field of clinical practice.
Pain management practitioners must possess a broad skill-set, advanced training and knowledge, and, perhaps above all else, clinical experience. Even so, there remain undeniable disparities in pain management education. Now that we recognize that the problems exist, further efforts must be made by our community to establish and assure clinical reliability and competency in the practice of pain medicine. As pain medicine expands as a subspecialty, so too must educational efforts.

Further reading

A percutaneous invasive procedure for pain relief in patients suffering from intolerable and intractable pain is commonly performed globally today. The physician needs to be trained and skilled in these procedures. Unfortunately, physicians from different specialties with poor training and skills continue to perform such procedures. To maintain the best standard of practice in interventional pain procedures, it is imperative that basic principles for performing the procedures are followed. They are described below.

**Preprocedure due diligence**

1. Is the physician eligible to perform the invasive procedure? The patient and/or the family should know that performing a technically complex invasive procedure requires the physician to be trained and eligible to do it. In advanced countries such as the United States or Europe, the protocol requires a credentialing process. This is to protect the patients' safety. Unfortunately, globally this credentialing process is not available. Patients and their families should make every effort in their local communities to ensure that the physician has a satisfactory reputation to perform these procedures, and that their training is accepted by local regulatory bodies. One example of acceptable training is obtaining a Fellow of Interventional Pain Practice (FIPP) Certificate from the World Institute of Pain (WIP).

2. Have a thorough history and the physical examinations been done on the patient and are there any contraindications to perform the procedure? It is the obligation of the physician to perform the procedures, and that their training is accepted by local regulatory bodies. One example of acceptable training is obtaining a Fellow of Interventional Pain Practice (FIPP) Certificate from the World Institute of Pain (WIP).

3. What is the objective of the physician in performing this procedure? It is the responsibility of the physician to explain to the satisfaction of the patient why a certain procedure needs to be considered, its expected result and its effects on the pain syndrome. This is presented in the form of “informed consent” in advanced countries. The patient agrees to have the procedure done by signing an official document.

4. Does the physician have knowledge of the anatomy of the procedure? It is the responsibility of the hospital or institution where the physician practices to determine whether they have experience and knowledge of the anatomy of the region for the invasive procedure about to be performed. This responsibility also lies with the patient or the family or both, who must determine by their own due diligence the physician’s capabilities. The hospital or the institution should only allow the physician to perform the procedure if they are satisfied with the physician’s eligibility.

5. Does the physician have knowledge of the needles, devices, and drugs to be used for the procedure? It is the responsibility of the hospital and institutions to evaluate and certify that the physicians who will perform the procedure have obtained adequate knowledge of the needles, devices, and drugs to be used in this procedure. This is usually done by the credentialing committee of the institution.

6. Is there an assistant in the room who is familiar with the procedure? Invasive procedures are complex and require other personnel to help the physician perform the procedure. The assistant, who should be familiar with the procedure, is valuable in monitoring the patient’s vital functions and assisting in equipment readiness and availability during the procedure.
**During the procedure**

7. Is the patient prepared appropriately? The first step is to position the patient appropriately for the procedure. Then, the patient should be prepared by placing an intravenous catheter and infusion system for drug injection. In addition to the common general set up, there should be an entry point in the tubing to inject the desired drug when it is required. All of this set up should be secured with adhesive tape in a sterile fashion.

8. Is the sedation adequately provided to the patient during the procedure? It is important to assess at this stage of procedure that the patient is comfortable and prepared to accept the procedure. If the patient is highly anxious, appropriate sedation to calm their anxiety is necessary. For instance, if the patient has to be kept awake to respond to the physician’s questioning during the procedure, then a very judicious dose of the sedative drug should be used. On the other hand, if being awake is not necessary, a safe, larger dose can be injected for the comfort and amnesia of the procedure.

9. Are the devices and machines tested before the procedure? As the patient is positioned and prepared, the physician should follow the checklist of required devices and machines to be used for the procedure. It is imperative that all devices are tested for correct functioning (e.g. radiofrequency equipment). Needles and devices should be readied for use in a sterile fashion.

10. Is there a trained assistant available for the procedure? A trained nurse or skilled assistant is necessary for moderate to complex invasive procedures such as trigeminal nerve lesioning or lumbar sympathetic ganglion lesioning. The assistant will not only help the physician during the procedure but also monitor the vital functions, assuring and calming the patient, and, when necessary, injecting the drugs.

11. Is the point of entry marked after the imaging machine is set in the correct position? After correct positioning of the patient and after obtaining intravenous access, the radiographic imaging machine should be tested and placed for the expected views needed for the procedure (i.e. posteroanterior–lateral oblique views).

The skin entry (of the needle) should be marked and confirmed by the imaging technique. After a correct confirmation of the needle entry, sterile draping of the region should be done, and the procedure started with injection of a local anesthetic. (Note: the physician must be appropriately protected from radiation and have sterile attire and gloves for the procedure.)

12. Once the needle is placed in the correct position, what are the appropriate steps taken to confirm it? When the physician determines that the needle is in the correct position, the next step should be to aspirate for fluid (blood or cerebrospinal fluid). If the aspiration is negative, confirm in all radiological views that the needle’s tip is in the correct position. After that is done, a diagnostic (local anesthetic) or therapeutic (neurolysis or radiofrequency) lesioning can be done. One should always use a contrast solution injection (iohexol) with radiographic image before therapeutic lesioning.

**After the procedure**

13. Is the postprocedure planned? It is essential that the patient, after the procedure, is taken to a place for monitoring (wherever possible in the recovery room or, alternatively, where vital functions can be monitored). The usual time for any postprocedure to be monitored is 30 minutes, but one should note that most complex procedures require up to 2 hours for patients’ vital functions to be stable.

14. Has the postprocedure family counseling been arranged? The patient, if cognitively stable, and the family should be counseled about the procedure just done, its expectations and side effects.

15. Have discharge instructions been given to the patient, family, or both? At discharge, the patient and family should be instructed when and how they should contact the physicians at the pain centre, if significant side effects occur from the procedure. The contact person’s telephone number should be available on a 24-hour basis. If everything is considered routine in the postprocedure period, then, at the time of discharge, a follow-up appointment should be given in writing (usually 2 weeks in the future).

16. What is the postprocedure follow-up? At 2 weeks (first follow-up), the progress of the patient should be assessed and documented to assess the efficacy of the procedure, the change in intensity of the pain before the procedure, and any side effects.

It is mandatory that the physician who performed the procedure send a detailed note to the referring physician of the procedure’s outcome, at the first follow-up. The note should also state if the physician plans further procedures on the patient in the future. If no other procedures are planned then the patient should be discharged back to the referring physician for further care.

It might be helpful for the patient and the family, hospital or institution, the physicians who perform the procedure, and for the personnel in the pain center to have a checklist of their responsibilities, before, during, and after the procedure.

**Further reading**


A detailed clinical history and assessment of the patient is essential before any intervention. The assessment should not be based on “is the procedure appropriate for the patient?” but “what type of treatment or interventional procedure is appropriate for the patient?”

Successful evaluation depends on the development of a mutually trusting relationship between the physician and the patient. The complaints and the expectations of the patient should be adequately analyzed. The physician should allot a minimum of 30 minutes at the first visit. If the patient is accompanied by a relative or a friend, it may be useful to get more information about the patient and their environment. The steps for the evaluation of the patient are as follows.

**Step 1.** Pain history
1. Detailed information about pain and associated symptoms since the very beginning.
2. Duration, intensity, frequency, and progress of pain.
3. The nature of pain, such as burning, stabbing, squeezing.
4. Factors that increase or decrease the pain.
5. Associated symptoms with pain.
6. Previous consultations or diagnosis related with pain.
7. Previous medications or treatments and the outcomes.
8. Current medications and other treatment modalities.

**Step 2.** General history of the patient
1. Other diseases (hypertension, diabetes, cardiovascular disease, renal failure, etc.).
3. Other treatments including surgery.
4. Addiction; smoking, use of alcohol, or drugs.

**Step 3.** Physical examination
1. General examination.
   (a) Mental status; level of consciousness, ability to reply to questions, concentration, mood, neurovegetative symptoms.
   (b) General appearance.
   (c) Blood pressure, heart rate, fever, weight, height.
   (d) Gait.
2. Musculoskeletal examination.
   (a) Posture.
   (b) Alignment of spine, shoulders, arm, lower back, and lower extremities.
   (c) Deformities.
   (d) Joints and bursa; tenderness, swelling, pain; especially temporomandibular joint, shoulder, elbow, wrist, coxofemoral, knee.
   (e) Myofascial trigger points; trapezius, splenius capitis, supraspinatus, temporalis, sternocleidomastoid, masseter, others.
3. Neurological examination.
   (a) Cranial nerves, especially trigeminal and glossopharyngeal nerve.
   (b) Motor examination: function of the upper and lower extremities, fingers, and toes should be checked. Muscle strength is assessed by the Medical Research Council Scale. The muscle strength should correspond to the nerve roots and peripheral nerves.
   (c) Sensory examination, sensorial loss, and paresthesia according to the dermatomal chart should be carefully checked. The lesions may be central, dermatomal (spinal), or peripheral nerve lesions.
   (d) Reflex testing: deep tendon reflexes may be a guide to the anatomical location of the lesion. Grading of the deep tendon reflexes is from 0 to 4+. Common reflex testers are biceps, triceps, patellar, and achilles.

**Physical examination of different regions of the body**

**Face**
The first step is the inspection of the face: changes on the face caused by herpes, sudomotor changes, trauma, and
mass lesions should be noted. The patient should also be checked intraorally for any lesions within the oral cavity.

Sensory testing is essential to verify any lesions of the cranial nerves.

Trigeminal neuralgia and glossopharyngeal neuralgia may be identified by palpation. Percussion of the sinuses will confirm sinusitis.

Neck, shoulder, and upper extremities

The second step is the examination of the neck, shoulder, and upper extremities.

The first aspect of this step should be the physical examination and inspection of the spine, which provides information on the posture and alignment of the patient. Kyphosis, lordosis, or scoliosis may be seen.

Tenderness during the palpation of the spine may indicate vertebral compression fracture, tumors, or abscess. Palpation may also indicate myofascial trigger points and facet arthropathy.

Normal range of motion of the cervical spine is 60° forward flexion, 75° of extension, 45° of lateral flexion, and 80° of lateral rotation.

Normal range of motion of the thoracolumbar spine is 90° forward flexion, 30° back extension, 25° of lateral flexion, and 60° of lateral rotation.

Pain provoked by back extension and lateral rotation may indicate facet arthropathy. Pain provoked by back flexion may indicate discogenic pain or pain originating from the vertebral body.

During inspection of the upper extremities, sudomotor changes, edema at the fingers, or swelling of the hands may indicate signs of complex regional pain syndromes.

Motor and sensory testing and testing of the deep tendon reflexes are also important for the upper extremities.

For the shoulder joint, asymmetry, the deltoid muscles, and posture should be inspected. The sternoclavicular joint, clavicle, acromioclavicular joint, glenohumeral joint, and the scapular spine should be palpated. The range of motion is very important for diagnosing several pathologies including “frozen shoulder.” The range of motion for the shoulder joint is 180° of flexion and extension with the sagittal plane, 180° of abduction and adduction with the frontal plane, 90° of external rotation, and 40° of internal rotation. Arthritis of the joints, subacromial and subdeltoid bursitis, supraspinatus and bicipital tendinitis, and rotator cuff tears and frozen shoulder are the common etiologies.

For the elbow joint, the range of motion is 30° of extension and 180° of flexion at the humeroulnar joint, and 170° of pronation and supination at the radioulnar joint. Lateral and medial epicondyritis are the common etiologies at the elbow joint.

The range of motion at the wrist is 60° of extension, 70° of flexion, 20° of abduction, and 30° of adduction. The most common etiology is carpal tunnel syndrome, which can be diagnosed by Tinel’s sign where percussion of the proximal volar wrist crease produces paresthesia in the thumb, index, and middle fingers, whereas Phalen’s sign is when the patient flexes both wrists against each other for one minute, and dysesthesia in the thumb, index, and middle fingers begins.

Thorax and abdomen

Inspection of the thorax should include herpetic lesions, traumatic lesions, masses, echymotic lesions, thoracic kyphosis, or scoliosis.

Although very rarely seen, discal hernia may also occur in the thoracic spine and dermatomal sensorial testing is necessary.

Palpation is more important for the abdomen to differentiate visceral and superficial pain.

Lumbosacral region

The lumbosacral region is perhaps the most important region for interventional procedures. Thus a thorough assessment of the patient is crucial. The physician should not try to fit the patient for a specific procedure; instead, try to find the best procedure and implement it only if it is necessary.

Examination of the lumbosacral region will begin by inspection. A global inspection will include the patient’s gain, posture, lumbar scoliosis, kyphosis, degree of spinal curvature, and lordosis. Signs of infection, herpes, and masses should also be inspected. The main structures that may be sources of pain are the intervertebral discs, facet joint, sacroiliac joints, and coccyx. The hip joint and bursitis of the trochanter major are also pain sources.

The range of motion for the lumbar spine is flexion to 90°, extension to 30°, bilateral lateral flexion up to 25°, bilateral rotation up to 60°.

The motor and sensory examination and examination of the deep tendon reflexes will reveal important information about the pain sources.

There are specific nerve-root tests. They are the heel test, which shows the L4–L5 function, and the toe walk, which tests the S1–S2 junction. Both are very important for decision-making for a transformaminal procedure.

Examination of the hip joint is also important. The range of motion is 100° of flexion, 30° for extension, 20° for adduction, and 40° for abduction. When the hip is flexed 45°, the range of motion is 45° for internal rotation and 40° for external rotation.

Trochanteric bursitis is also a pain source. There is tenderness during palpation over the trochanter major.

There are several special tests such as the straight leg raise test for nerve root pathology or piriformis syndrome, Patrick’s test for the sacroiliac joint, and the back extension test for facet arthropathy.

The physical examination of the patient should overlap with the pain history and radiological findings. One of the serious
Psychological assessment (contributed by Özlem Sertel-Berk)

Currently, since the interacting effects of biological, psychological, and social factors on the pain process have been realized, the psychological preparedness of the patient with chronic pain is of great importance when the extent of that pain requires an invasive intervention either for diagnostic purposes or extenuating pain. This necessity of searching for adequateness for surgical operations stems from the fact that if the patients are not good candidates, the interventions may result in inflations in the severity of pain or multiple somatic complaints in various body sites. Moreover, surgical operations may adversely affect the biopsychosocial functioning of the individual. As a result of these factors, there is a tremendous increase in research concerning biopsychosocial factors predicting the success rates of invasive procedures when chronic pain patients are evaluated.

Within the scope of these parameters, practical issues about the assessment of the most crucial biopsychosocial variables in predicting the adequateness of patients with chronic pain for surgical interventions will be addressed in two major topics: first, which pain patients are better for referral for psychological assessment; second, what the points of emphasis should be during psychological assessment.

Conditions requiring psychological assessment before surgical intervention

Which pain patients should be the candidates for psychological assessment intending to schedule for an invasive procedure? What are the criteria by which the assessment is made?

Scope of psychological assessment

What is meant by convenience for candidacy is by no means based solely on the psychological assessment. First, a comprehensive psychological assessment is required to capture not only the psychological characteristics but also the sociological/cultural environmental issues affecting the patient with pain; moreover, and, significantly, the biological features of the pain experience itself should also be assessed. However, is it necessary to refer every single patient who is planned for an invasive procedure for psychological assessment? Epker and Block (2001) suggest cost-effectiveness as one of the criteria. In line with this suggestion, the referring physician should consider if such an evaluation before an invasive procedure will determine the outcome of the procedure. Several criteria can be formulated to evaluate this factor, based upon Sternbach’s (1986) “abnormal pain behavior” and Engel’s (1959) “pain prone patient” conceptualizations, which are as follows.

1. A past history of numerous medical investigations and poor effectiveness of those treatments.
2. Poor compliance in recommended pre-procedure execution of pain algorithms; i.e., irrational utilization of pain medicine, frequent drop-outs and/or analgesic abuse.
3. An excessive verbiage of pain (how frequently does the patient talk about his/her pain, pain discourse).
4. An exaggerated postural behavior or facial expression due to pain (a skewed or hunchbacked position, hobbling, frowning, depressive look).
5. Poor daily functioning, which is not explainable.
7. An incongruence between the descriptions of pain and scientific and/or clinical recognitions of pathophysiology and pathoanatomy of the pain in question.
8. Patient’s poor cognitive grasp of the complexity of pain.

If one or more of the above observations are evident, regardless of an objective organic pathology underlying their pain, these patients need to be referred for a comprehensive psychological assessment.

Explaining the need for a psychological assessment

All of the above criteria bring out the issue of how the physician should communicate the information to the patient that he or she will primarily be referred for a psychological evaluation. First, because it has been reported that for many patients the phrase “psychological evaluation” can be challenging, within the field of health psychology the term “behavioral medicine consultation” is offered instead. Substituting this phrase may decrease the patient’s resistance to a referral.

Nevertheless, when asked for a referral, whether for a psychological assessment or for a behavioral medicine consultation, patients should not get the impression that the reason is because nothing was observed about the organic origins of their pain complaint, and that therefore they are not suitable for a surgical intervention.

1. From the beginning, the patient should be told that the purpose behind sending them to a psychologist is the necessity for evaluating the degree of benefits they will get from a surgical implementation.
2. The conversation between the physician and the patient should aim to clarify the psychological issues that may hinder a positive outcome, where the patient can be further informed that in some cases psychological preparation can even lead to improved outcomes.
3. Therefore, it is crucial for the physician to explain and discuss the biopsychosocial nature of pain with the patient, even before any medical assessment is used. If this is not the case, the patient is likely to hold a negative belief that the physician thinks the pain is not real, which further increases