

---

*Solving the Enigma of the*  
**Safe Sacroiliac Fusion**  
**Clinical Appreciation of the Sacroiliac Problem**

By

John G. Stark, MD

©2024

**VOLUME I**

History, Clinical Elements and Indications

---

*It is my great privilege to offer these thoughts and insights into the challenges of sacroiliac fusion. To every degree possible, the model is developed and made consistent with known anatomy, patient care considerations, and orthopedic principles. Put forward as an academic submission, it will be subject to welcome efforts to be questioned, debated, and confirmed. The reader is reminded that the information is a developing effort, subject to study by qualified and credentialed practitioners who can understand the model and safely apply it to the individual patient.*

*John G. Stark, September 2024*

**Dr. John Stark** is a board-certified orthopedic surgeon licensed in Minnesota, USA. During his career, he has enjoyed many contributing experiences; he has been a member of The Orthopedic Foot and Ankle Society, The Orthopedic Trauma Association, The Orthopedic Research Society, and The North American Spine Society. He is Board-certified in Arthroscopy, a Clinical Instructor of Orthopedic Surgery in children's foot surgery, and has been Clinical Assistant Professor of Orthopedic Surgery at the University of Minnesota.

Early in his practice, he was dedicated to general orthopedics, performing total hip and knee replacement, shoulder surgery, arthroscopy, and foot and ankle surgery. Trained primarily at the Veterans Administration Medical Center, he had developed a lasting interest in the surgical treatment of the degenerative spine. He sees these varied experiences as complementary, having critical roles in developing insights regarding the sacroiliac joint.

After the MRI was introduced in the late 1980s, a wealth of new information became available for treating low back disease. The advances in imaging confirmed and reinforced his philosophy that emphasized anatomic bases for spinal and nerve root-related complaints. Better imaging allowed approaches emphasizing reconstructive elements to address the interconnected mechanical and neurological symptomatology more comprehensively.

In 1993, shortly after Dr. Stark's transition from general orthopedics to a full-time spine focus, a critical patient presented with a new onset of uncharacteristic hemipelvic pain. This pain began after a well-healed lumbar fusion. Dr. Stark determined that it was not a hip problem, and even though he had no such experience, he surmised that it originated from the sacroiliac joint. That patient was referred elsewhere, underwent one of the historical methods of SIJ fusion, and suffered a long, difficult recovery. The recognitions associated with this index patient sparked a lifelong interest in understanding, assessing, and treating the sacroiliac joint.

Within his practice, and demanding new attention, SIJ outlier syndromes became familiar: asymmetric buttock pain, sitting intolerance, pain in the presence of normal or inconsistent MRI findings, new recurrent pain after successful surgery, and insufficient pain relief from technically well-done lumbar surgery. Faced with an increasing number of such patients in need of significant relief for their SIJ pain, Dr. Stark began to perform SIJ surgery based on parallels of other fusion techniques in 1999, 25 years ago. Refinements in the surgical method followed and, thereafter, the related discovery of a preoperative imaging protocol, reproducible radiologic landmarks, and instrument-based control.

Initially, the posteromedial approach applied historical methods of dowel and tricortical allograft, but techniques were limited by graft quality and availability. Applications of allograft were not teachable or reproducible. A metal cylindrical implant was then adopted as a neutral spacer; although this, too, was a step forward, additional technical steps became necessary, including placement into a prepared, properly sized channel. Titanium plasma spray and hydroxyapatite followed as accelerating adjuncts to incorporation and healing.

---

All challenges were compounded by the acuity and severity of patients' pain-related distress. Though similar in pain level, fracture pain could often be alleviated with immobilization and pain medication; this type of pain would be expected to ultimately resolve with healing. The most severe SIJ patients, however, got no relief without surgery. Once applied, technical-surgical success became deeply interrelated with clinical success. Indications became firmer, and contraindications based on psychological factors became relative. The most desperate patients, including those complicated by depression and anxiety, did benefit --- dramatically.

Dr. Stark's career and teachings have been influenced by three distinguished individuals: trauma surgeon Dr. Raymon Gustilo who instilled a sense of directed urgency for patients' acute needs; Dr. Robert (Bud) Premer, Chief of Orthopedics at the Minneapolis Veterans Administration Medical Center, who fully engaged with the suffering of the disadvantaged and disenfranchised; and Dr. Roby Thompson, Chief of Orthopedic Surgery at the University of Minnesota, who taught reverence for academic study and principle. All have embodied the best of orthopedic practice and have been lifelong sources of inspiration through myriad orthopedic encounters, drawing upon energy, humanity, and truth. Dr. Stark expresses gratitude to Dr. Marc Swiontkowski, the subsequent Chief of Orthopedic Surgery at the University of Minnesota, who, later in Dr. Stark's career, awarded him exposure to orthopedic trauma at Regions Hospital, the Level 1 Trauma Center for the city of St. Paul. Dr. Stark believes that every orthopedic surgeon should have the benefit of such experiences.

*“For over 100 years, the SIJ has been recognized as a painful orthopedic problem, and it is now overdue for a solution. Historical treatment approaches have left a trail of evidence suggesting improvements allowing treatment success. The insights presented in these volumes are recognizable and similar to other orthopedic discoveries over this period. Like those discoveries, they will demand the same diligent execution of principled care.*

*I sincerely and humbly hope that students of the low back find insights and inspiration as they approach the clinical challenges of the sacroiliac joint. I believe that the suggested model in this book will advance care, not just for the spine and sacroiliac joint but, through the reinforcement of principles generally, for all suffering patients.”*

John Stark, MD

Minneapolis, Minnesota, USA

July 15, 2024

# Annotated Table of Contents

---

## 0.0 Book Synopsis: Introduction

---

This book is a highly illustrated text that examines the complex anatomy and pathophysiology of the sacroiliac joint. It addresses ongoing debates within medical communities over surgical treatment. Exploring the evidence for each sacroiliac fusion method aims to uncover crucial elements and challenges. The difficulty in identifying and treating illnesses related to the sacroiliac joint is explored in depth, and the importance of adhering to orthopedic principles is emphasized. By the end of the book, readers will have an appreciation for vulnerable sacroiliac anatomy and understand how to safely address sacroiliac disease and treat the whole patient.

## Volume I - History, Clinical Elements and Indications

---

### 1.0 Lessons From History

---

The failure of SIJ pain treatment over time deserves some explanation. Sacroiliac joint pain has always been a significant cause of back pain, but achieving diagnostic criteria was challenging. The lack of successful surgical procedures to vet diagnostic criteria and the lack of widely accepted differential between other spinal health issues has compounded the problem. With medical training focusing on either the spine or the limb, the medical community often overlooked the sacroiliac joint; it has not been well-taught or well-understood. The historical methods of SIJ fusion were deficient in orthopedic principles, frequently resulting in erroneous diagnosis and nonunion.

### 2.0 Special Nature of the SIJ

---

The sacroiliac joint is a synovial joint resulting from forced articulation between spinal bone and limb bone. Its constrained position within the pelvis makes it susceptible to extreme force concentration and cyclic loading. The joint is a fulcrum for various forces, and its location at the “crossroads” of the trunk and lower extremity makes it vulnerable to injury and disease.

### 3.0 Conservative Treatment

---

This chapter presents the author’s perspective regarding the appropriateness of nonsurgical methods, their relation to the suffering of degenerative disease, and their overuse. The experienced caregiver may notice how SIJ pain differs; it does not respond to traditional lumbar-based methods or correlate with standard imaging. A constructive approach would value nonoperative treatment methods both therapeutic and diagnostic. To begin the diagnostic process, the patient may vaguely define the SIJ pain complaint. However, with experience, the response to conservative treatment methods will bring the SIJ into focus, excluding competing regional diagnoses, including the lumbar spine, hip, and viscera.

---

## 4.0 Indications for Sacroiliac Fusion

---

Diagnosing sacroiliac joint pain is crucial for timely treatment but challenging. A detailed medical history is essential capturing pain onset, patterns, aggravating factors, and exact location. Tools like the Pain Diagram, Million Visual Analog Scale, McGill Pain Questionnaire, and Oswestry Disability Index aid in the precise diagnosis and effective treatment planning. The author's preferred method of physical diagnosis is discriminating, gentle, and complete, appropriate for all practitioners. Creative use of complementary interventional radiology and imaging reinforces diagnostic findings. The indications are consistent with other areas of orthopedics, incorporating pain severity and functional loss into the decision-making process.

## 5.0 Imaging

---

CT interpretation must be supported by history, examination, and relevant tests; surgical-level complaints necessitate appropriately timed CT study, including minimized radiation techniques. Proper imaging extends beyond defining degenerative changes into other findings using multiple planes. Degenerative and radicular concerns may warrant selective nerve root injection or discography. CT scans also combine with fluoroscopy, surgical navigation, and multiplanar imaging to aid in safe implant placement, the interpretation of surgical findings, and postoperative confirmation. Correlating the patient's clinical presentation to critical imaging observations should be emphasized.

**6.0 Impingement, Sacrolisthesis, Entrapment, Critical Zone Concept, and Gauntlet Phenomenon**

---

This chapter explores extra-axial causes of radiculopathy, emphasizing the significance of factors leading to nerve impingement. Clinical familiarity with these regional factors is underscored; it is essential in cases with ambiguous symptoms or poor treatment response. Imaging changes indicative of degeneration and neural impingement are discussed. Convincing radicular patterns are discussed. This is important, particularly at the inferior SIJ, where degenerative changes encroach on major vascular structures. New concepts are introduced, including the “Critical Zone Concept” (the interaction of nerves and vessels at the inferior SIJ) and the “Gauntlet Phenomenon” (where extraspinal exposed roots are subject to repeated compressive threats).

**7.0 Safety**

---

The literature presents conflicting views on SIJ fusion efficacy. Some argue there is insufficient evidence for fusion, while others advocate for various methods, including laterally-based “minimal incision” fusion. Early adopters may have overlooked severe complications such as bleeding and nerve injury, rationalizing it as a necessary risk of sacroiliac fusion. These adverse events are well documented in the FDA’s MAUDE (Manufacturer and User Device Experience) database. Severe ethical and technical aspects must be carefully weighed when evaluating the risks patients and surgeons face; are patients sufficiently informed about severe and avoidable risks?

**8.0 Cylindrical Implant Theory**

---

The SIJ and surrounding structures provide receptive anatomy to accommodate a cylindrical implant. This implant is positioned to reach the center of the SIJ, blocking important motion axes that cause pain. In the circumstance of fusion, blocking this motion enhances incorporation. The implant’s rounded shape disperses forces to the native vestigial intertransverse processes. Strong ligaments provide elastic compression, trapping the implant. When an implant is used unilaterally, the SIJ bone density accepts distracting forces and impacts both the targeted and contralateral SIJ through a force-dispersing quasi-articular mechanism.

**9.0 The Posteromedial Approach as a Solution to Safe Sacroiliac Fusion**

---

This summary chapter provides an overview of the clinical aspects related to the SIJ in preparation for a more detailed discussion in Volume II on the posteromedial SIJ fusion technique.

### **10.0 Precise Execution of the Posteromedial SIJ Fusion Technique**

---

Posteromedial fusion has been attempted in the past but failed to gain widespread adoption. In retrospect, failures can be attributed to the effective disregard of orthopedic principles. This includes the imprecision that results from bone-based grafting and the absence of a precise and reproducible instrumentation technique.

The author's posteromedial method and technical steps are presented. The proposed posteromedial approach to SIJ fusion avoids nerves and unnecessary trauma while minimizing tissue manipulation and bleeding. The properly loaded implant of the distraction-interference arthrodesis achieves healing goals and corrects deformity. Tips and tricks for performing implant-assisted distraction-interference arthrodesis of the sacroiliac joint are discussed.

### **11.0 Postoperative Considerations**

---

This chapter emphasizes the precautions and support during the postoperative circumstance, including partial weight-bearing, vitamin D, and other common-sense measures. Proper counseling and healthy communication with the patient are reinforced.

Surgeons are encouraged to fully evaluate patients after surgery to rule out common factors interfering with patient outcomes before discharging them to other providers. This book offers insights into the posteromedial surgical method to relieve patient discomfort and restore function. Any deviation in patient outcome warrants careful evaluation for common causes of pain, delayed recovery, or misunderstandings. Patient issues should be comprehensively readdressed via thorough history review, examination, and imaging.

### **12.0 Rescue and Revision of the Posteromedial SIJ Fusion: Complications and Salvage**

---

For individual patients, specific steps should be taken for prolonged or atypical pain patterns, including reviewing preoperative and postoperative Pain Diagrams and examinations. Other pain sources sometimes surface following successful fusion.

The posteromedial approach's utility poses a unique opportunity to salvage circumstances without causing more damage. The safe position of the cylindrical implant allows it to work around previously placed implants with a reasonable expectation that bony union will still occur. There is a need to study the previously placed implants with multiplanar techniques as they may interfere with guide pins or the posteromedial implants.

The posteromedial method is amenable to revision. In most cases, the implant is removed by turns, and the next-size implant is placed. Technical steps and considerations are discussed and illustrated.

---

### **13.0 Rescue and Revision of Alternative Methods: Complications and Salvage**

---

There is a call to reevaluate the “minimal incision” methods as a standard for sacroiliac fusion, especially considering the risks and the limited benefits demonstrated by the sham-controlled study (Randers, 2024). As a result, surgeons will be reconsidering their ongoing use of the laterally-based SIJ fusion approach. The anatomy is prohibitive, and there remains a consistent presence of worrisome reports in the FDA’s MAUDE database. The anatomy is not amenable to a lateral approach, the mechanics are unfavorable, the preparation steps are clumsy, the healing is unpredictable, and the revision opportunities are unappealing.

**Bibliography: A comprehensive bibliography is found at the end of Volume III.**