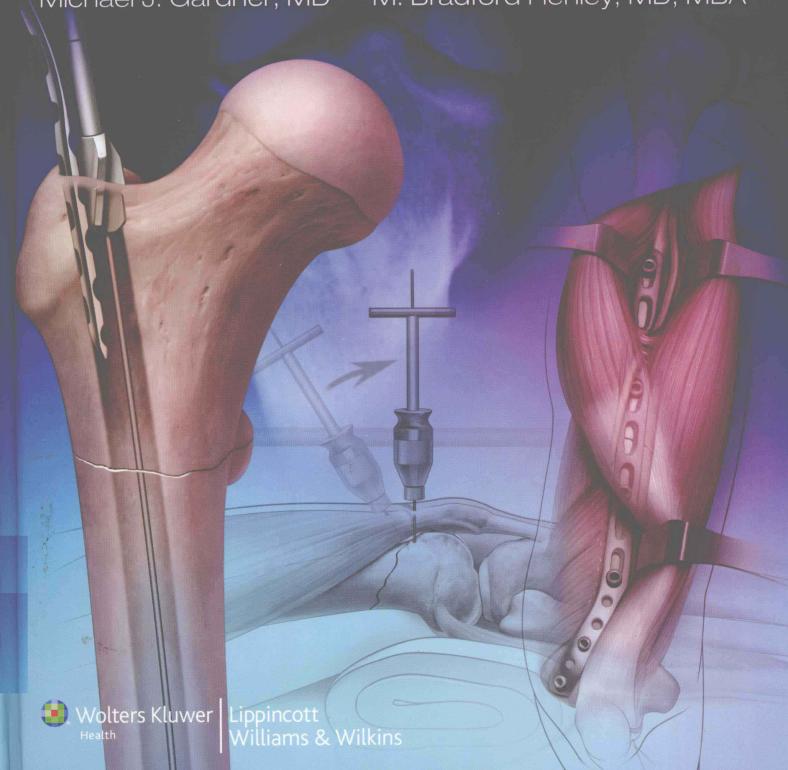
HARBORVIEW

Illustrated Tips and Tricks in

FRACTURE SURGERY

Michael J. Gardner, MD M. Bradford Henley, MD, MBA





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FRACTURE SURGERY

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FOREWORD

Bruce Douglas Browner, MD, MS, FACS

When I was a resident during the mid-1970s, fracture management revolved around the use of plaster casts and traction. Young men with femur fractures remained hospitalized for weeks, lying in beds inclined on wooded boxes to counteract the pull of heavy weights. They were then placed in plaster spica casts for several months. Open fractures were treated with pins in plaster and the Orr method. Osteomyelitis and amputations were common. Some fractures were opened and fixed with straight nails or plates, but the indications were inconsistent and unclear. Custom-molded plastic bracing and functional treatment were introduced by Sarmiento and his fracture courses in Miami were very popular. The faculty at the one I attended as a senior resident included a little-known surgeon from Seattle named Sigvard "Ted" Hansen. He reported on the initial results from Harborview Hospital with the closed nailing technique they had learned when Gerhard Kuntscher visited. To support his case for the superiority of the technique, he argued that animals with endoskeletons were more advanced than those with exoskeletons. Ted later noted that this presentation I witnessed was the launching for closed nailing and the beginning of the transition to a new era of treatment for long bone fractures.

I traveled to Davos for the annual AO course as a chief resident. There was a small zealous group of mostly European surgeons who were developing a system of internal fixation that was not yet embraced by American orthopaedic surgeons. The precisely designed Swiss implants and equipment and highly organized approach to operative fracture care were very appealing. When this system was introduced in the United States, the emphasis on early rigid fixation and rapid mobilization caused a major shift in fracture care. During this period, external fixation had a revival in the United States and was used extensively for open fractures, which were prevalent as the United States reached the peak of road traffic deaths and injuries.

Working at the Maryland Shock Trauma Center, housed then in an old wing of the hospital, I was a participant in and a witness to the birth of a new field called orthopaedic trauma. The focus became optimal care of seriously injured patients and treatment of complex musculoskeletal injuries. We incorporated the new techniques and moved away from the old methods. A pivotal moment occurred at the 1983 AAOS meeting in Las Vegas when Bob Winquist presented the highly positive Harborview experience with the closed nailing of 504 femoral fractures. Because of its significance, the presentation was scheduled in the slot before the first vice presidential address and was heard by an audience of thousands in a massive rotunda ballroom. Gus Sarmiento the leading apostle of functional bracing, who was the discussant, acknowledged that the technique offered unprecedented advantages and would change the standard of care.

Over the subsequent 27 years, the field of orthopaedic trauma has evolved constantly and modern fracture management has spread throughout the world. The orthopaedic faculty at Harborview have been among the leading groups in the subspecialty. Serving as the trauma-referral center for surrounding states, they have consistently been receiving large volume of patients, which allowed them to develop a large group of orthopaedic trauma faculty. They have amassed a large collective experience and completed many important clinical studies. Their emphasis on excellence and constant pursuit of improved methods of care has enabled them to establish and refine a series of protocols for operative management. Surgeons from all over the world visit the center to observe their approach to trauma care. Their orthopaedic trauma fellowship is considered the premier experience in the country.

Brad Henley, MD, MBA, a veteran member of the Harborview Orthopae-dic Trauma group, has used his clinical expertise and business leadership skills

to organize an outstanding surgical technique atlas. Members of the Harborview Orthopaedic Trauma faculty and current and former orthopaedic trauma fellows created the various chapters. A consistent approach was used combining very high quality intraoperative photos and beautiful halftone line drawings. Details of surgical technique are conveyed in brief notes, which form legends for each illustration.

This treatise will provide valuable supplementation on surgical management and technique to the information contained in major fracture texts. There is a growing need for this type of detailed "how to do it" guidance. Successive global burden of disease and injury analyses document a growing prevalence of road traffic injuries, particularly in the developing world. The problem stems from vulnerable road travelers sharing the roads with heavy vehicles and public transportation that are overcrowded and dangerous. Increasing numbers of deaths and injuries result and disabling musculoskeletal disabilities are causing major social and economic impact. Rapid motorization in populous, economically powerful countries such as India and China is casing a surge in injuries to occupants of cars. Airbags, seat belts, and improved car design have decreased the fatality rate in developed countries, but severe lower extremity injuries are not prevented by current measures. Medical systems in many countries are evolving to levels where surgeons will be able to employ modern methods of internal and external fixation to avoid disabilities. This Harborview book will be an extremely useful resource that will assist them with the quest for optimal patient care.

PREFACE

I developed the idea for this book nearly 15 years ago. Like most orthopaedic surgeons, I learned surgical operations by reading about a specific or preferred technique. This was followed by observing the procedure as performed by a mentor. At some point in my training, I began performing these operations as the operating "surgeon," usually with the assistance of a senior physician. After I was awarded my first academic position at University of Texas Southwestern Health Science Center at Dallas (UTHSCD) and Parkland Hospital, I performed them independently. Also similar to most orthopaedic surgeons, after "reading one, doing one, and teaching one," I would frequently modify certain aspects of the operation to make it "better" and to improve my surgical efficiency. Throughout my career, I have continued to "refine" procedures, using what I believe are more effective and efficient methods of accomplishing the task of obtaining an anatomical reduction (an "ORIF" instead of an "OIF").

After leaving UTHSCD, I joined the University of Washington (UW) faculty at Harborview Medical Center (HMC). When I arrived in February 1988, the full-time faculty at HMC numbered only five: Sigvard "Ted" Hansen, Keith Mayo, Paul A. Anderson, Stephen K. Benirschke, and Bruce J. Sangeorzan. Steve and Bruce had recently completed fellowships in Trauma and Foot & Ankle, respectively. Later in 1988, Marc Swiontkowski joined our team expanding our number to seven. Ted, Bruce, and Paul had a nontrauma orthopaedic specialty as their primary clinical interest, though all took trauma call and cared for patients with musculoskeletal injuries. Over the next decades, the Harborview's Orthopaedic faculty contracted and expanded. Currently, we have eight full-time faculty trauma surgeons and Ted Hansen with more than 179 years of postfellowship trauma experience. Supplementing these core trauma surgeons are the other faculty based at HMC who share in covering trauma call, hand call, or spine call; I believe that the orthopaedic group at Harborview is the largest trauma group with the greatest accumulated experience treating musculoskeletal injuries in the nation (~280 physician years). Table 1 summarizes the orthopaedic faculty appointments and departures since my arrival at HMC.

The faculty at Harborview have a long history dedicated to graduate and post-graduate medical education. Beginning in the 1970s, they offered an opportunity for physicians desiring a greater trauma experience to spend time at the institution dedicated to the care of patients with musculoskeletal injuries. Both academic and community orthopaedists availed themselves of this experience and would spend either 3 or 6 months working with the residents and faculty. It was not until the mid-1980s that a few surgeons would stay for a year at a time. With the formation of the Orthopaedic Trauma Hospital Association (OTHA, the organization preceding the Orthopaedic Trauma Association [OTA; www.ota.org]), two 1-year long orthopaedic trauma fellowship positions were offered. By the late 1980s, after Marc Swiontkowski's and my arrival at HMC, three Advanced Clinical Experience (ACE) positions were offered per year. Over the next two decades, the number of positions expanded gradually from the initial three, to four, then five, and finally to the six trauma ACE positions we offer today. (Table 2 summarizes the chronology of HMC Orthopaedic Trauma ACEs.)

Being an orthopaedic trauma attending at Harborview Medical Center in Seattle allowed me to establish a practice devoted full time to musculoskeletal trauma. Performing operations, repetitively, provided many opportunities to devise my own set of tips and tricks. However, working at Harborview has also allowed me to work with some of the world's foremost thought leaders and best technical orthopaedic trauma surgeons. This environment has been conducive to collaboration and refinement of patient care. Our weekly fracture conference is renowned as it allows discourse and debate of the treatments for acute ortho trauma by six-twelve orthopaedic trauma surgeons. Additionally, my colleagues and I can often "visit" with each other in between cases to observe each other's techniques and technical tips.

¹I ascribe this vernacular to the insights and surgical perfectionism of my partner and friend "Stevie B" (Stephen. K. Benirschke MD): ORIF — open reduction with internal fixation; OIF — open....with internal fixation.

Table 1. Harborview–Based UW Orthopaedic Faculty from 1988 to 2009					
Last name, First name	Hire Date	Current or Depart Date			
Hansen, Sigvard T.	7/1/1968	current			
Winquist, Robert A.	7/1/1974	5/25/1980			
Veith, Robert G.	7/1/1980	3/31/1984			
Mayo, Keith A.	6/25/1984	11/12/1990			
Sack, John T.	7/1/1984	current			
Anderson, Paul A.	7/1/1985	4/30/1994			
Benirschke, Stephen K.	1/1/1986	current			
Sangeorzan, Bruce J.	4/1/1987	current			
Henley, M. Bradford	2/1/1988	current			
Swiontkowski, Marc	5/1/1988	9/1/1997			
Routt, M. L. Chip	7/1/1989	current			
Trumble, Thomas E.	7/1/1989	current			
Smith, Douglas G.	7/1/1990	current			
Chapman, Jens R.	8/1/1991	current			
Hanel, Douglas P.	6/1/1992	current			
Mirza, Sohail	9/1/1995	8/31/2008			
Nork, Sean E.	8/1/1998	current			
Allan, Christopher H.	9/1/1998	current			
Mills, William J.	9/10/1998	7/2/2004			
Bellabarba, Carlo	10/1/1999	current			
Barei, David P.	8/1/2000	current			
Taitsman, Lisa A.	8/1/2002	current			
Bransford, Richard J.	10/6/2003	current			
Beingessner, Daphne M.	8/1/2004	current			
Dunbar, Robert P.	9/15/2005	current			
Krieg, James C.	7/1/2007	current			
Huang, Jerry I.	9/1/2008	current			

This has allowed us to disseminate our own ideas and those of our colleagues by incorporating each other's tricks, tips, and treatment philosophies into the care of our own patients and our educational philosophy.

Over the past 15 years, I have often thought of codifying these tips and tricks in journal articles or book form. Some tips and tricks have been published by HMC ACEs in orthopaedic journals but many ideas of the HMC trauma faculty are unpublished. It has been a habit of the ACEs to keep a diary or record of their cases noting surgical tips, tricks, and techniques. In September of the 2007-2008 ACE year, I pitched my idea to our six trauma fellows (Mike Brennan, Andy Evans, Jason Evans, Mike Gardner, Zach Roberts, and Ray Wright). I was greeted with enthusiastic support. Each of the ACEs digitally recorded their observations and lessons learned after each case or at the end of the day. They illustrated their notes with digital images saved from the image intensifier and planar radiographs during their 1-year experience. Their hand drawings were converted to medical illustrations by Scott Bodell, a superb medical illustrator whom I met while at UTHSCD (1985-1988). These image files were appended to their recorded observations and serve to illustrate many of the tips and tricks. This book is therefore the result of a single year's observations of select cases made by six orthopaedic trauma ACEs (8/2007–7/2008), each of whom was assigned authorship of one or more chapters.

Over the course of the year, Mike Gardner demonstrated an affinity for this book concept. He used his leadership skills to help me organize the project and served as the liaison with his peers. Based on his academic interest and his early and sustained contributions to the manuscript, I suggested that he serve as coeditor with me. Each ACE was assigned authorship of one or more chapters.

Mike and I understand that HMC is an orthopaedic center for the germination and coalescence of ideas and techniques. This is facilitated by a continuing stream of scholars, visitors, and physicians who seek education and advanced training. Together with the faculty, these individuals help catalyze the refinement of ideas and techniques, which lead to new techniques and improved patient care. We know that musculoskeletal trauma care will continue to evolve in the future. It is our hope that HMC and our ACE disciples will continue to maintain leadership roles through research and collaboration.

The editors and authors make no claim to many of the techniques, "tips," and "tricks" described in this publication. Instead, we view it as a compilation of those techniques that were used by the HMC faculty and observed and chronicled in a 1-year period by our six orthopaedic trauma ACEs. Some of these techniques were learned from interactions with our national and international colleagues while others may be accurately ascribed to a specific HMC faculty member. Some of these ideas may have been published previously by other authors and this is referenced only if we were aware of the prior publication.

I would like to dedicate this book to all of my colleagues (orthopaedists and nonorthopaedists) who provide emergency medical services to humankind. Should family or friends need emergency trauma care, I am glad to know that I can depend on the many trauma surgeons and physicians who have trained at Harborview and at the other excellent trauma centers in the United States. I want to acknowledge, especially, all of my past and present teachers and mentors (especially Professor Dr. med. Bernd Claudi and Dr. Kenneth D. Johnson), current and former (UTHSCD and UW/HMC) faculty colleagues, OTA colleagues and members, and HMC ACEs [see Tables 1 and 2]. It is these individuals and their disciples who have dedicated their careers to providing the emergency trauma services and are continuing graduate and postgraduate education needed by our nation. Most importantly, I want to thank my domestic partner Ann Rutledge; my parents, Ernest and Elaine; my daughters, Taryn and Cailin; and my colleagues and friends for their support and help during this project.

Thank you very much Brad Henley

When I first visited Harborview during my residency, I attended the weekly fracture conference. After witnessing the postoperative fracture conference and X-ray presentations, I knew immediately I wanted to learn and emulate the quality, techniques, and style of fracture fixation that seemed to be consistent among all faculty. During my fellowship at Harborview, this conference was among the many highlights. The postoperative review of many fluoroscopic images in succession, often 15 or 20, made it possible to follow along the progression of the procedure, step by step. The subtleties of clamp placements for specific fracture fragments, reduction sequences for common fracture patterns, and the rationale for particular implant choices and positions were often discussed. This was an extremely effective way to teach and learn the technical aspects of fracture surgery. My co-fellows and I began to jot down names of interesting patients during the conference, and would later review and save the images. A critical mass of particularly demonstrative cases was obtained, and formed the basis of the present text. I have subsequently revisited these chapters countless times prior to operations, and hope it can similarly provide other

young fracture surgeons with useful techniques. Participating in this "extra-curricular" activity during my fellowship and early career would not have been possible without the endless support and understanding from my wife, Katie, and daughter, Kelsey.

I hope that you will enjoy this compilation of tips, tricks and surgical cases that my colleagues and I have compiled.

Thank you Mike Gardner

Table 2. Chronology of HMC Orthopaedic Trauma ACEs				
Name	Begin Date	End Date	Length (mo)	
Stuyck, Jos	10/13/1978	9/17/1979	11	
Weber, Michael	10/1/1979	12/31/1979	3	
Jackson, Robert	1/1/1980	6/30/1980	6	
Marcus, Randall	4/1/1980	6/30/1980	3	
Johnson, Kenneth D.	12/1/1980	6/15/1981	6	
Shammas, Sameer	7/1/1980	12/31/1980	6	
Jacobson, Wells	1/1/1981	3/31/1981	3	
Kellam, James	4/1/1981	6/30/1981	3	
Burney III, Dwight	7/1/1981	9/30/1981	3	
Burman, William	10/1/1981	12/31/1981	3	
Ratcliffe, Steven	1/1/1982	3/31/1982	3	
Gerhart, Tobin	4/1/1982	6/30/1982	3	
Webb, Lawrence	7/1/1983	12/31/1983	6	
Moody, Wayne	1/3/1984	2/29/1984	2	
LaMont, Justin	7/1/1984	6/30/1985	12	
Wilber, John	7/1/1984	6/30/1985	12	
Cotler, Howard	1/1/1985	6/30/1985	6	
Lhowe, David	7/1/1985	12/31/1985	6	
Moye, Daniel	7/1/1985	6/1/1986	11	
Carr, James	8/1/1985	7/31/1986	12	
Cornell, Charles	1/1/1986	6/30/1986	6	
Jonassen, E. Andrew	7/1/1986	6/30/1987	12	
Keeve, Jonathan	7/1/1986	12/31/1986	6	
Donovan, Thomas	1/1/1987	4/30/1987	4	
Benca, Paul	7/1/1987	6/30/1988	12	
Carr, Charles	7/1/1987	12/31/1987	6	
Kaehr, David	7/1/1987	6/30/1988	12	
Verdin, Peter	7/1/1987	6/30/1988	12	
Mirels, Hilton	7/1/1988	1/31/1989	7	
Routt, Chip	7/1/1988	6/30/1989	12	
Gruen, Gary	1/1/1989	6/30/1989	6	
Agnew, Samuel	7/1/1989	7/31/1990	13	
Santoro, Vincent	7/1/1989	7/15/1990	12	
Peter, Robin	7/16/1990	7/15/1991	12	
West, Gregory	7/16/1990	7/15/1991	12	
Chapman, Jens	8/1/1990	1/31/1991	6	
Kottmeier, Stephen	1/1/1991	7/31/1991	7	
Cramer, Kathryn	8/1/1991	7/31/1992	12	

Table 2. Continued				
Name	Begin Date	End Date	Length (mo)	
Meier, Mark	8/1/1991	7/31/1992	12	
Patterson, Brendan	8/1/1991	7/31/1992	12	
Grujic, Les	8/1/1992	7/31/1993	12	
Ott, Judson	8/1/1992	7/31/1993	12	
Selznick, Hugh	8/1/1992	7/31/1993	12	
Brokaw, David	8/1/1993	7/31/1994	12	
Handley, Robert	8/1/1993	7/31/1994	12	
Teague, David	8/1/1993	7/31/1994	12	
McNamara, Kevin	4/1/1994	7/31/1994	4	
Hubbard, David	8/1/1994	7/31/1995	12	
Schwappach, John	8/1/1994	7/31/1995	12	
Twaddle, Bruce	8/1/1994	7/31/1995	12	
Weber, Tim	8/1/1994	7/31/1995	12	
Clark III, Carey	8/1/1995	7/31/1996	12	
Desai, Bharat	8/1/1995	7/31/1996	12	
Krieg, James	8/1/1995	7/31/1996	12	
Thomson, Gregory	8/1/1995	7/31/1996	12	
Harding, Susan	8/1/1996	7/31/1997	12	
Harvey, Edward	8/1/1996	7/31/1997	12	
Mormino, Matt	8/1/1996	7/31/1997	12	
O'Byrne, John	8/1/1996	7/31/1997	12	
Cole, Peter	8/1/1997	7/31/1998	12	
Jones, Cliff	8/1/1997	7/31/1998	12	
Nork, Sean	8/1/1997	7/31/1998	12	
Russell, George	8/1/1997	7/31/1998	12	
Kuo, Roderick	8/1/1998	7/31/1999	12	
Sanzone, Anthony	8/1/1998	7/31/1999	12	
Segina, Daniel	8/1/1998	7/31/1999	12	
Tejwani, Nirmal	8/1/1998	7/31/1999	12	
Barei, David	8/1/1999	7/31/2000	12	
Hymes, Robert	8/1/1999	7/31/2000	12	
Schildhauer, Thomas	8/1/1999	7/31/2000	12	
Schwartz, Alexandra	8/1/1999	7/31/2000	12	
Ertl, William	8/1/2000	7/31/2001	12	
Fowble, Coleman	8/1/2000	7/31/2001	12	
Ringler, James	8/1/2000	7/31/2001	12	
Vallier, Heather	8/1/2000	7/31/2001	12	
Camuso, Matthew	7/1/2001	8/31/2002	14	
McNair, Patrick	7/1/2001	8/31/2002	14	
Taitsman, Lisa	8/1/2001	7/31/2002	12	
Wagshul, Adam	8/1/2001	7/31/2002	12	
Wiater, Patrick	8/1/2001	7/31/2002	12	
Coles, Chad	8/1/2002	7/31/2002	12	
Dunbar, Robert	8/1/2002	7/31/2003	12	
Hammerberg, Eric Mark	8/1/2002	7/31/2003	12	
Polonet, David	8/1/2002	7/31/2003	12	
Smith, Carla	8/1/2002	7/31/2003	12	
Beingessner, Daphne	8/1/2003	7/31/2004	12	
beingessiier, Dapinie	0/1/2003	// 31/ 2004	14	

Table 2. Continued				
Name	Begin Date	End Date	Length (mo)	
Farrell, Eric	8/1/2003	7/31/2004	12	
Howlett, Andrew	8/1/2003	7/31/2004	12	
Molnar, Rob	8/1/2003	7/31/2004	12	
Stafford, Paul	8/1/2003	7/31/2004	12	
Conflitti, Joseph	8/1/2004	7/31/2005	12	
Della Rocca, Gregory	8/1/2004	7/31/2005	12	
Gomez, Arturo	8/1/2004	7/31/2005	12	
Osgood, Gregory	8/1/2004	7/31/2005	12	
Weiss, David	8/1/2004	7/31/2005	12	
Bryant, Ginger	8/1/2005	7/31/2006	12	
Graves, Matthew	8/1/2005	7/31/2006	12	
Greene, Craig	8/1/2005	7/31/2006	12	
Howard, James	8/1/2005	7/31/2006	12	
O'Mara, Timothy	8/1/2005	7/31/2006	12	
Yoo, Brad	8/1/2005	7/31/2006	12	
Kubiak, Erik	8/1/2006	7/31/2007	12	
Mehta, Samir	8/1/2006	7/31/2007	12	
Mirza, Amer	8/1/2006	7/31/2007	12	
Puttler, Eric	8/1/2006	7/31/2007	12	
Summers, Hobie	8/1/2006	7/31/2007	12	
Viskontas, Darius	8/1/2006	7/31/2007	12	
Brennan, Michael	8/1/2007	7/31/2008	12	
Evans, Andrew	8/1/2007	7/31/2008	12	
Evans, Jason	8/1/2007	7/31/2008	12	
Gardner, Michael	8/1/2007	7/31/2008	12	
Roberts, Zachary	8/1/2007	7/31/2008	12	
Wright, Raymond	8/1/2007	7/31/2008	12	
Calafi, Leo	8/1/2008	7/31/2009	12	
Maroto, Medardo	8/1/2008	7/31/2009	12	
Morshed, Saam	8/1/2008	7/31/2009	12	
Nwosa, Chinedu	8/1/2008	7/31/2009	12	
Oldenburg, Frederick	8/1/2008	7/31/2009	12	
Orec, Robert	8/1/2008	7/31/2009	12	
Bishop, Julius	8/1/2009	7/31/2010	12	
Cross, W. Woodie	8/1/2009	7/31/2010	12	
Dikos, Greogry	8/1/2009	7/31/2010	12	
Glasgow, Don	8/1/2009	7/31/2010	12	
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Patient Positioning

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