

CONTENTS

List of Tests and Exercises	ix
Preface	xi
Acknowledgments	xiii
Photo Credits	xiv
Why and How You Should Read This Book	xv

PART I Scientific Foundation **1**

CHAPTER 1 Introduction to the Issues **2**

Legislative Landscape: The Unfortunate Adverse Impact on Bad Backs	3
Deficiencies in Current Low Back Disorder Diagnostic Practices	3
<i>Is It True That 85% of Back Troubles Are of Unknown Etiology?</i>	5
<i>Diagnosis by Hypothesis Testing</i>	5
<i>Is It True That Most Chronic Back Complaints Are Rooted in Psychological Factors?</i>	6
<i>Does Pain Cause Activity Intolerance?</i>	7
Inadequacies in Current Care and Prevention of Low Back Disorders	7
<i>Ill-Advised Rehabilitation Recommendations</i>	8
<i>Can Back Rehabilitation Be Completed in 6 to 12 Weeks?</i>	10
<i>Should the Primary Goal of Rehabilitation Be Restoring the Range of Motion?</i>	11
<i>What Are Better Alternatives in Dealing With Painful Backs?</i>	11
Mechanical Loading and the Process of Injury: A Low Back Tissue Injury Primer	11
A Final Note	14

CHAPTER 2 Scientific Approach Unique to This Book **15**

In Vitro Lab	15
In Vivo Lab	16
<i>How the Virtual Spine Works</i>	16
<i>Development of the Virtual Spine</i>	21

CHAPTER 3 Epidemiological Studies on Low Back Disorders (LBDs) **22**

Multidimensional Links Among Biomechanical, Psychosocial, and Personal Variables	22
<i>Three Important Studies</i>	23
<i>Do Workers Experience LBDs Because They Are Paid to Act Disabled?</i>	24
<i>Does Pain Have an Organic Basis—Or Is It All in the Head?</i>	25
<i>Are Biomechanical Variables and Psychosocial Variables Distinct?</i>	28
<i>What Is the Significance of First-Time Injury Data for Cause and Prevention?</i>	28
How Do Biomechanical Factors Affect LBD?	29
<i>Mechanical Loading and LBD: Field-Based Risk Factors</i>	29
<i>What Are the Lasting Physiological, Biomechanical, and Motor Changes to Which Injury Leads?</i>	30
<i>What Is the Optimal Amount of Loading for a Healthy Spine?</i>	31
What Are the Links Between Personal Factors and LBD?	32
What the Evidence Supports	33

CHAPTER 4 Functional Anatomy of the Lumbar Spine 35

- Basic Neural Structure 35
- Vascular Anatomy 36
- The Vertebrae 36
 - Vertebral Architecture and Load Bearing 36 • Posterior Elements of the Vertebrae 41*
- Intervertebral Disc 44
 - Load-Bearing Abilities 44 • Progressive Disc Injury 44*
- Muscles 47
 - Muscle Size 48 • Muscle Groups 49 • Abdominal Muscles 56 • Psoas 60 • Quadratus Lumborum 61 • Muscle Summary 62*
- Ligaments 62
 - Longitudinal Ligaments 63 • Interspinous and Supraspinous Ligaments 63 • Other Ligaments in the Thoracolumbar Spine 65 • Normal Ligament Mechanics and Injury Mechanics 65*
- Lumbodorsal Fascia (LDF) 66
- A Quick Review of the Pelvis, Hips, and Related Musculature 67
- Clinically Relevant Aspects of Pain and Anatomic Structure 70
 - Tissue-Specific Types of Pain 70 • Can Pain Descriptors Provide a Reliable Diagnosis? 71*
- A Final Note 71

CHAPTER 5 Normal and Injury Mechanics of the Lumbar Spine 72

- Kinematic Properties of the Thoracolumbar Spine 72
- Kinetics and Normal Lumbar Spine Mechanics 76
 - Loads on the Low Back During Functional Movements 76 • Loads on the Low Back During Various Exercises 87*
- Dubious Lifting Mechanisms 91
 - Intra-Abdominal Pressure 92 • Lumbodorsal Fascia 94 • Hydraulic Amplifier 95 • IAP, LDF, and Hydraulic Amplifier: A Summary 95*
- Other Important Mechanisms of Normal Spine Mechanics 95
 - Biomechanics of Diurnal Spine Changes 96 • Spinal Memory 96 • Anatomical Flexible Beam and Truss: Muscle Cocontraction and Spine Stability 97*
- Injury Mechanisms 98
 - Summary of Specific Tissue Injury Mechanisms 98 • Injury Mechanics Involving the Lumbar Mechanism 99 • Staying Within the "Biomechanical Envelope" 99*
- Biomechanical and Physiological Changes Following Injury 108
 - Tissue Damage Pathogenesis, Pain, and Performance 108 • Injury Process: Motor Changes 109 • Specific Patterns of Muscle Inhibition Following Injury 110 • The Crossed-Pelvis Syndrome and Gluteal Amnesia 110*

CHAPTER 6 Myths and Realities of Lumbar Spine Stability 113

- Stability: A Qualitative Analogy 113
- Quantitative Foundation of Stability 114
 - Potential Energy as a Function of Height 115 • Potential Energy as a Function of Stiffness and Elastic Energy Storage 117 • Muscles Create Force and Stiffness 118 • Sufficient Stability 119*
- Stability Myths, Facts, and Clinical Implications 119

PART II Injury Prevention **123**

CHAPTER 7 LBD Risk Assessment **124**

- Brief Review of the Risk Factors for LBD 124
- NIOSH Approach to Risk Assessment 125
 - 1981 Guideline 125 • 1993 Guideline 126
- Snook Psychophysical Approach 127
- Lumbar Motion Monitor (LMM) 127
- Ergowatch 128
- Biological Signal–Driven Model Approaches 130
 - The Marras Model and the McGill Model 130 • EMG-Assisted Optimization 131
 - Simple or Complex Models? 131
- The Challenge Before Us 131

CHAPTER 8 Reducing the Risk of Low Back Injury **133**

- Lessons From the Literature 133
 - Compensation Board Statistics—an Artifact? 134 • Ergonomic Studies 134 • Rehab and Prevention Studies 134 • Studies on the Connection Between Fitness and Injury Disability 135 • Beyond Ergonomics: Is It Time to “Modify” the Worker? 135
- LBD Prevention for Workers 136
 - Should Workers Avoid End Range of Spine Motion During Exertion? 136 • What Are the Ways to Reduce the Reaction Moment? 138 • Should One Avoid Exertion Immediately After Prolonged Flexion? 143 • Should Intra-Abdominal Pressure (IAP) Be Increased During Lifting? 144 • Are Twisting and Twisting Lifts Particularly Dangerous? 145
 - Is Lifting Smoothly and Not Jerking the Load Always Best? 145 • Is There Any Way to Make Seated Work Less Demanding on the Back? 148 • Some Short-Answer Questions 150
- LBD Prevention for Employers 152
- Injury Prevention Primer 154
- A Note for Consultants 157

CHAPTER 9 The Question of Back Belts **158**

- Issues of the Back Belt Question 158
- Scientific Studies 159
 - Clinical Trials 159 • Biomechanical Studies 161 • Studies of Belts, Heart Rate, and Blood Pressure 162 • Psychophysical Studies 163
- Summary of Prescription Guidelines 163

PART III Low Back Rehabilitation **165**

CHAPTER 10 Building Better Rehabilitation Programs for Low Back Injuries **166**

- Our Five-Stage Back Training Program 166
- Finding the Best Approach 167
- Stages of Patient Progression 169
 - Stage 1: Detect and Correct Perturbed Motion and Motor Patterns 169 • Stage 2: Establish Stability Through Exercises and Education 181 • Stage 3: Develop Endurance 182

Guidelines for Developing the Best Exercise Regimen	183
<i>Developing a Sound Basis for Exercise Prescription</i>	183 • <i>Basic Issues in Low Back Exercise Prescription</i>
<i>184</i>	
CHAPTER 11 Evaluating the Patient	189
The Most Crucial Element in Evaluation	189
First Clinician–Patient Meeting	190
Some Provocation Tests	192
<i>A Note on Motion Palpation</i>	198 • <i>Distinguishing Between Lumbar and Hip Problems</i>
198	
Some Functional Screens	199
<i>The “Stiff” Spine</i>	203 • <i>Control of Torsional Motion</i>
203 • <i>Testing for Aberrant Cross Lumbar Motion</i>	204
Testing Muscle Endurance	210
CHAPTER 12 Developing the Exercise Program	213
Philosophy of Low Back Exercise Design	213
Clinical Wisdom	214
<i>Sparing the Back While Stretching the Hips and Knees</i>	214 • <i>Flossing the Nerve Roots for Those With Accompanying Sciatica</i>
216	
Identifying Safe and Effective Exercises	217
<i>Incorporating and Patterning the Muscles</i>	218 • <i>Eliminating Unsafe Exercises</i>
218 • <i>Selecting Safe and Effective Exercises</i>	220
Beginner’s Program for Stabilization: A Sample	221
Exercises That May Be Used in a Stabilization Program	222
CHAPTER 13 Advanced Exercises	230
Safely Increasing Challenges	231
<i>Labile Surfaces and Resistance Training Machines</i>	231 • <i>Safely Progressing Back Exercises</i>
233	
Occupational and Athletic Work Hardening	236
<i>Low Back Exercises for High-Performance Workers or Athletes</i>	236 • <i>Low Back Exercises Only for Athletes</i>
238	
Looking Forward	241
Epilogue	243
Handouts for Patients or Clients	244
Appendix	268
Glossary	274
References and Additional Readings	276
Index	301
About the Author	312