

---

# Contents

Dedication .....	iii
Acknowledgments .....	x
Preface to the Fourth Edition .....	xi
Preface to the Third Edition .....	xii
Preface to the Second Edition .....	xiii
Preface to the First Edition .....	xiv
Foreword to the Fourth Edition .....	xv
Foreword to the Third Edition .....	xvi

## Section One: Machine Technology

Machine Overview .....	2
Bimanual Microincision Phaco: Alternate Irrigation Path .....	4
Foot Pedal .....	6
Irrigating Bottle .....	12

### Flow Pumps

Flow Pumps: Overview and Peristaltic Pump .....	16
Scroll Pump .....	18
Flow Pumps: Direct Control of Flow and Indirect Control of Vacuum .....	20
Flow Pumps: Tip Occlusion Effects on Flow and Vacuum .....	24
Flow Pumps: Direct Vacuum Control with Tip Occlusion .....	26
Rise Time: Flow Pumps .....	28
Rise Time: Flow Pump Compliance .....	30
Rise Time: Flow Pump Venting and Vacuum Limit Preset .....	32
Schematic Machine; Flow Pump .....	34
Relationship Among Flow Rate, Rise Time, and Vacuum .....	36
Relationship Between Flow and Vacuum 1 .....	48
Relationship Between Flow and Vacuum 2 .....	50

### Vacuum Pumps

Vacuum Pumps: Overview and Venturi .....	52
Diaphragm Pump .....	54
Rotary Vane Pump .....	56
Vacuum Pumps: Direct Control of Vacuum and Indirect Control of Flow .....	58
Vacuum and Flow Pumps: Flow Resistance .....	60
Vacuum Pumps: Control of Flow and Grip; Vacuum Transfer Upon Tip Occlusion .....	62
Vacuum Pumps: Direct Control of Vacuum and Grip .....	64
Vacuum Pump Emulation by Flow Pumps .....	66

Control Strategy: Flow Pump vs Vacuum Pump .....	70
Rise Time: Vacuum Pumps .....	72
Vacuum Pumps: Relationship Between Rise Time and Vacuum .....	74
Vacuum Pumps: Pedal Control of Rise Time .....	80

### **Clinical Fluidics**

Fluidic Resistors Affecting Flow: Vacuum Pump .....	82
Fluidic Resistors Affecting Flow: Vacuum Pump vs Flow Pump .....	84
Fluidic Resistors Affecting Vacuum: Flow Pump .....	86
Vacuum Degradation in Aspiration Line .....	88
Bottle Height: Relationship to Flow .....	90
Baseline Resistance to Flow .....	92
Flow Control: Vacuum vs Flow Pumps .....	94
Compliance and Air Venting .....	96
Compliance and Fluid Venting .....	98
Surge .....	100
External Surge Suppression .....	106

### **Ultrasound**

Ultrasound Overview .....	108
Sculpt vs Occlude .....	110
Ultrasound: Gel vs Solid .....	112
Ultrasound Power Modulations: Linear Continuous .....	114
Ultrasound Power Modulations: Fixed Panel Continuous .....	116
Ultrasound Power Modulation: Pulse Mode .....	118
Ultrasound Power Modulation: Burst Mode .....	120
Ultrasound Power Modulation: HyperPulse .....	122
Ultrasound Power Modulations: Decreased Ultrasound Time .....	124
Pulse and Burst Modes Contraindication with Sculpting .....	126
Phaco Needle Tip Angles: Occludability 1 .....	128
Phaco Needle Tip Angles: Occludability 2 .....	130
Tip Angles and Aspiration Port Surface Area .....	132
Phaco Needle Dimensions .....	134
Ultrasonic Cavitation and Needle Design .....	136
Thermal Implications of Ultrasound: Needle Designs .....	138
Alternate Modalities of Phacoemulsification: Ultrasound Variations .....	142
Alternate Modalities to Ultrasound: Laser .....	144
AquaLase and Laser Surgical Techniques .....	146
Irrigation and Aspiration Tips .....	148
Individual Machine Characteristics .....	150

## **Section Two: Logic of Setting Machine Parameters**

Overview of Logic Behind Setting Machine Parameters .....	154
---	-----

Anterior Chamber Currents .....	156
Flow Rates and Currents .....	158
Force and Currents .....	160
Flow and Vacuum Settings 1: Distal Followability .....	162
Flow and Vacuum Settings 2: Proximal Followability .....	164
Flow and Vacuum Settings 3: Grip .....	166
Control Inputs and Aspiration Port Occlusion: Flow Pumps vs Vacuum Pumps .....	168
Parameter Modulation with Hardware Modification .....	170
Sculpting Settings: Vacuum, Flow, and Bottle Height .....	172
Sculpting Settings: Ultrasound .....	174
Linear Phaco Sculpting .....	176
Quadrant Settings 1 .....	178
Quadrant Settings 2 .....	180
Settings for Quadrant/Fragment Emulsification: Balancing Fluidics and Ultrasound .....	182
Phaco Chop Settings: Horizontal Chop .....	186
Modified Horizontal Chop: Stop and Chop 1 .....	188
Modified Horizontal Chop: Dynamic Linear Parameter Adjustment .....	190
Vertical Chop Settings 1 .....	194
Vertical Chop Settings 2 .....	196
Epinucleus Settings 1 .....	198
Epinucleus Settings 2 .....	200
Cortical Removal Settings .....	202
Viscoelastic Removal Settings .....	204

### **Section Three: Overview of Phacoemulsification Techniques**

Overview of Phaco Methods .....	208
Sculpting Angle of Attack .....	212
Minimum Groove Width .....	214
Posterior Groove .....	216
Judging Groove Depth .....	218
Peripheral Groove .....	220
Physical Obstructions to Sculpting .....	222
Use Low to Moderate Scope Magnification .....	224
Tip Manipulations for Sculpting Groove .....	226
Avoiding Iris During Sculpting .....	228
Layers of the Lens .....	230
Hydrodissection Fluid Dynamics .....	232
Nuclear Rotation: Torque Principles .....	234
Nuclear Rotation: Clinical Application of Torque .....	236
Rotating Nucleus: Pulling with Phaco Tip .....	238

Rotating Nucleus: Effects of Friction	240
Optimal Instrument Placement for Nuclear Manipulation	242
Nuclear Segmentation 1	244
Nuclear Segmentation 2	246
Nuclear Segmentation 3	248
Nuclear Segmentation 4	250
Fault-Line Phaco	252
Horizontal Chopping Techniques 1	256
Horizontal Chopping Techniques 2	258
Horizontal Chopping Techniques 3: Seibel Chopper	260
Horizontal Chopping Techniques 4: Flat-Head Phaco Tip	262
Vertical Chopping Techniques	264
Chopper Instrumentation	266
Akahoshi Prechop	268
Vacuum Seal	270
Vacuum Seal: Needle Bevel	276
Fragment Manipulation 1	278
Fragment Manipulation 2	280
Fragment Manipulation 3	282
Fragment Manipulation 4: Viscodissection	284
One-Handed Strategies 1	286
One-Handed Strategies 2	288
Pivot Around Incisions 1	290
Pivot Around Incisions 2	292

#### **Section Four: Irrigation and Aspiration Techniques**

Cortical Classification	296
Cortical Removal: Large Pieces Instead of Small Bites	298
IA Port Turned Posteriorly	300
Capsule Vacuum	302
Manual Cortical Removal	304
90° and 45° IA Tips	306
Bimanual Irrigation and Aspiration	308
Using the IOL to Help Remove Cortex	310
Epinuclear Mobilization via Cortical Pulley	312

#### **Section Five: Physics of Capsulorrhexis**

Stress and Strain	316
Shear vs Rip	318
Capsulorrhexis with Shearing	320
Capsulorrhexis with Ripping	322
Maintaining Chamber Depth	324

Combining Techniques .....	326
Capsulorrhexis Initiation 1 .....	328
Capsulorrhexis Initiation 2 .....	330
Capsulorrhexis Initiation 3 .....	332
Capsulorrhexis Initiation 4 .....	334
Anterior Cortical Opacities .....	336
Capsulorrhexis Enlargement .....	338

**Section Six: Phacodynamic Complications**

Complication 1 .....	342
Complication 2 .....	344
Complication 3 .....	346
Complication 4 .....	348
Complication 5 .....	350
Complication 6 .....	352

**Appendices**

Appendix A: Implied Surface Area in Units of mm Hg .....	356
Appendix B: Aspiration Port Surface Area Derivation .....	358
Appendix C: Summary of Pressure Terminology .....	360
Appendix D: Phacodynamic Analysis in Instrument Design .....	362
Bibliography .....	369
Index .....	371