

Contents

1	Diabetic Macular Edema	1
	Conceição Lobo, Isabel Pires, and José Cunha-Vaz	
1.1	Introduction	1
1.2	Pathophysiology of Retinal Edema	2
1.3	Extracellular Edema	2
1.4	Starling's Law	3
1.5	Incidence and Prevalence of DME	3
1.6	Clinical Evaluation of Macular Edema	4
1.7	Diagnosis and Classification	4
	References	18
2	Ischemia	23
	Suk Ho Byeon, Min Kim, and Oh Woong Kwon	
2.1	Retinal Ischemia	23
2.2	Brief Anatomy of Retinal Circulation	24
2.3	Fluorescein Angiography (FA) and Optical Coherence Tomography (OCT): Anatomic Correlations	24
2.4	"External Fovea" in OCT	26
2.5	Detection of Ischemic Retinal Area: Comparisons Between Fluorescein Angiography and OCT	27
2.6	Pathologic Changes and Relevant OCT Findings in Ischemic Tissues	28
2.7	Prominent Middle Limiting Membrane	28
2.8	Retinal Artery Occlusion	29
2.9	Central Retinal Artery Occlusion	29
2.10	CRAO with Cilioretinal Artery Sparing	32
2.11	Cilioretinal Artery Occlusion	33
2.12	Branched Retinal Artery Occlusion	33
2.13	Ophthalmic Artery Occlusion	33
2.14	Cotton Wool Spots	35
2.15	Combined CRAO and CRVO	36

2.16	Ocular Ischemic Syndrome	37
2.17	Evaluation of Retinal Perfusion State on OCT	37
2.18	Central retinal vein occlusion (CRVO)	37
2.19	Central retinal vein occlusion	40
2.20	Diabetic Retinopathy	41
2.21	Diabetic Ischemic Maculopathy	41
2.22	Choroidal Ischemia	43
	References	45
3	Optical Coherence Tomography and Visual Acuity: Photoreceptor Loss	51
	Adzura Salam, Ute Ellen Kathrin Wolf-Schnurrbusch, and Sebastian Wolf	
3.1	Introduction	52
3.2	Principle of SD-OCT	52
3.3	SD-OCT in Normal Eyes	53
3.4	SD-OCT in Retinal Diseases	53
3.5	Correlation Between Visual Acuity and Integrity of Photoreceptor in Retinal Diseases	54
3.5.1	Photoreceptor	54
3.5.2	Diabetic Macular Edema	54
3.5.3	Retinal Vein Occlusion	59
3.5.4	Retinal Artery Occlusion	62
3.5.5	Age-Related Macular Degeneration	65
3.5.6	Central Serous Chorioretinopathy	71
3.5.7	Retinitis Pigmentosa	71
3.5.8	Foveal Microstructure and Visual Acuity in Selected Surgical Retina Cases	75
3.6	Conclusion	81
3.7	Summary for Doctor	81
	References	81
4	Optical Coherence Tomography Updates on Clinical and Technical Developments. Age-Related Macular Degeneration: Drusen and Geographic Atrophy	87
	Monika Fleckenstein, Steffen Schmitz-Valckenberg, and Frank G. Holz	
4.1	Introduction	87
4.2	Early AMD	88
4.2.1	In Vivo Visualization of Drusen and Pigmentary Changes by Spectral-Domain Optical Coherence Tomography	88
4.2.2	Quantification of Drusen Volume by Spectral-Domain Optical Coherence Tomography	91

4.3	Geographic Atrophy	93
4.3.1	Phenotypic Features of Atrophy and Identification of Predictive Markers by Spectral-Domain Optical Coherence Tomography	93
4.3.2	Correlation with Other Imaging Modalities	94
4.3.3	Quantification of Atrophy by Spectral- Domain Optical Coherence Tomography Imaging	100
4.4	Future Perspectives	102
	References	103
5	Optical Coherence Tomography in Glaucoma	109
	Fatmire Berisha, Esther M. Hoffmann, and Norbert Pfeiffer	
5.1	Introduction	109
5.2	Imaging in Glaucoma	110
5.3	Time-Domain Optical Coherence Tomography in Glaucoma	111
5.4	Spectral Domain Optical Coherence Tomography in Glaucoma	112
5.5	Diagnostic Ability of Spectral Domain OCT in Glaucoma	117
5.6	Future Directions of Optical Coherence Tomography in Glaucoma	119
	References	120
6	Anterior Segment OCT Imaging	125
	Alexandre Denoyer, Antoine Labbé, and Christophe Baudouin	
6.1	Introduction	125
6.2	Principles of Anterior Segment OCT	126
6.3	Clinical Applications	127
6.3.1	Corneal Thickness Assessment	127
6.3.2	Corneal Grafts	127
6.3.3	Corneal Refractive Surgery	128
6.4	Phakic Intraocular Lens	131
6.5	Glaucoma	132
6.6	Conclusion	137
	References	137
7	Optical Coherence Tomography: A Concept Review	139
	Pedro Serranho, António Miguel Morgado and Rui Bernardes	
7.1	Introduction	139
7.2	The Genesis of OCT	141
7.3	The Physical Principle	142
7.4	Low-Coherence Light Interferometer	144
7.5	Time-Domain Optical Coherence Tomography	146
7.6	Spectral-Domain Optical Coherence Tomography	147
7.7	Swept-Source Optical Coherence Tomography	148
7.8	Polarization-Sensitive Optical Coherence Tomography	149

7.9	Full-Field Optical Coherence Tomography	150
7.10	Quantum Optical Coherence Tomography	151
7.11	Latest Developments and Future Directions	152
	References	153
8	Evaluation of the Blood–Retinal Barrier with Optical Coherence Tomography	157
	Rui Bernardes and José Cunha-Vaz	
8.1	Introduction	157
8.2	Blood–Retinal Barrier	158
8.3	Clinical Evaluation of the Blood–Retinal Barrier	159
8.4	Quantitative Evaluation of the Blood–Retinal Barrier	159
8.4.1	Confocal Scanning Laser Ophthalmoscopy	160
8.5	Retinal Leakage Analyzer	161
8.6	Noninvasive Evaluation of Blood–Retinal Barrier with OCT	163
8.6.1	Data of Healthy Volunteers vs. Patient Data	163
8.6.2	Differences Within the Same Eye and Scan	164
8.6.3	Automatic Classification	168
8.7	Conclusions	172
	References	173
9	Polarization Sensitivity	175
	U. Schmidt-Erfurth, F. Schlanitz, M. Bolz, C. Vass, J. Lammer, C. Schütze, M. Pircher, E. Götzinger, B. Baumann, and C.K. Hitzenberger	
9.1	Polarization-Sensitive Optical Coherence Tomography	175
9.1.1	Principles of Polarization-Sensitive OCT	176
9.1.2	Polarization Properties of Ocular Structures	179
9.1.3	Segmentation Algorithms	182
9.2	Imaging of the Eye with Polarization-Sensitive OCT	186
9.2.1	Age-Related Macular Degeneration	187
9.2.2	Glaucoma	193
9.2.3	Diabetic Maculopathy	196
9.3	Conclusion and Future Directions	198
	References	199
10	Adaptive Optics in Ocular Optical Coherence Tomography	209
	Enrique Josua Fernández and Pablo Artal	
10.1	Introduction	209
10.2	The Eye as an Optical System and Adaptive Optics	211
10.3	Transverse Resolution in OCT	212
10.4	Effect of Aberration Correction in Contrast and Resolution	216
10.5	Correction of Ocular Monochromatic Aberrations in OCT	219
10.5.1	Time Domain	219
10.5.2	Frequency Domain	221

10.6	Aberration Pancorrection in UHR OCT: Toward Isotropic and Subcellular Resolution	226
10.6.1	Pancorrection: Full Aberration Correction	226
10.6.2	UHR OCT and Pancorrection of Aberrations	229
10.7	Summary	231
	References	232
11	The SL SCAN-1: Fourier Domain Optical Coherence Tomography Integrated into a Slit Lamp	237
	F.D. Verbraak and M. Stehouwer	
11.1	Introduction	237
11.2	The SL SCAN-1 Device	238
11.3	Scanning the Anterior and the Posterior Segment	239
11.4	Scanning the Periphery with the SL SCAN	239
11.5	Scanning Through a Three-Mirror Contact Lens with the SL SCAN	239
11.6	Scanning with the Fundus Viewer, an Add-On Lens	240
11.7	Examples of Subjects Studied	241
11.8	Results	241
11.8.1	Scans of the Posterior Pole Obtained Through a Handheld Lens (Posterior Mode)	242
11.8.2	Scans of the Peripheral Retina Obtained Through a Handheld Lens or Three-Mirror Lens (Posterior Mode)	242
11.8.3	Scans of the Anterior Segment Obtained Directly (Anterior Mode) and Through a Three-Mirror Lens (Posterior Mode)	243
11.8.4	Thickness Measurements of the Posterior Segment with the Fundus Viewer and FastMap (Posterior Mode)	244
11.9	Discussion	246
	References	248
	Index	251