

1	Introduction	1
2	Basic Concepts	3
2.1	Basic Principles of MRI	3
2.1.1	Design of a Magnetic Resonance Unit	6
2.1.2	Radiofrequency Coils	6
2.1.3	Basic Conduct of the MRM Examination	7
2.2	Contrast Media in MRI	8
2.3	Medical Significance of Breast Tumors	9
2.4	Breast Imaging Modalities	16
2.4.1	X-Ray Mammography	16
2.4.2	Sonography	20
2.4.3	Thermography	21
2.4.4	Computed Tomography	22
2.4.5	Angiography	22
3	Brief Review of the Development of Magnetic Resonance Mammography	23
3.1	Development of MRM	23
3.2	Present Investigations	24
4	Present Indications for MRM	27
5	Optimum Procedure for the MRM Examination	29
5.1	History	29
5.2	Procedure	29
5.3	Problems and Sources of Error in MRM	31
5.3.1	Problems of Patient Selection	31
5.3.2	Problems of Positioning	32
5.3.3	Problems of Imaging	32
5.3.4	Errors in Injecting the Contrast Medium	34
5.3.5	Errors of Image Interpretation	34
6	Clinical Aspects	37
6.1	General Criteria for Image Interpretation	37
6.2	The Normal Breast	38
6.3	Carcinoma	42
6.4	Fibroadenoma	52

6.5	Cysts	58
6.6	Scars	59
6.7	Mastopathies	62
6.8	Special Cases	66
6.8.1	Status After Plastic Surgery	66
6.8.2	Inflammatory Carcinoma, Mastitis	67
6.8.3	Nipple and Skin Changes	67
6.8.4	Status After Irradiation	68
6.8.5	Postoperative Complications	72
6.8.6	Lactating Breast	77
6.8.7	Breast Diseases in Males	81
6.8.8	Apocrine Carcinoma	84
6.8.9	Cystosarcoma Phylloides	84
6.9	Comparison of the Results of MRM and X-Ray Mammography	87
7	Teaching Examples	89
8	Interpretation	343
8.1	General	343
8.2	The Normal Breast	345
8.3	Carcinoma	346
8.4	Fibroadenoma	349
8.5	Cysts	349
8.6	Mastopathies	349
8.7	Scars	350
8.8	Lactating Breast	350
8.9	Comparison of MRM Results with X-Ray Mammography	351
8.10	Future Outlook	351
9	Summary	353
Appendix: Research on the Development and Optimization of the Examination Technique		355
A.1	MRI Equipment	355
A.2	Coils for Breast Examination	355
A.2.1	Coil Development	355
A.2.2	Comparison of Three Different Breast Coils	358
A.3	Examination Parameters	362
A.4	Spin-Echo Examination Technique	363
A.5	Gradient-Echo Sequences: Test Phase	366
A.6	Dynamic Examinations	374
A.7	3D-Dynamic Gradient-Echo Examinations	378
A.8	In Vitro Studies of MR Contrast Enhancement	383
A.9	Two-Dimensional Multislice FLASH Sequence	389

	Contents	VII
A.10	Spectroscopic Examinations	396
A.10.1	^{31}P NMR Spectroscopy	396
A.10.2	^1H NMR Spectroscopy	396
	Acknowledgment	401
	References	403
	Subject Index	415