

Contents

Contributors

Foreword by Nairn HF Wilson

Preface to the Second Edition

Preface to the First Edition

vii

ix

xi

xiii

1. Introduction to Endodontics

1

Definitions 1

Scope of endodontics 1

Evolution of endodontics 1

Outcome of endodontic therapy 6

Factors of prognosis 6

Future of endodontics 7

2. Biology of Pulp–Dentin Complex

9

Structure of dentin–pulp complex 9

Development of dentin–pulp complex 10

Dentin 10

Chemical composition 11

Components of dentin 11

Dentin permeability 13

Smear layer and smear plugs 14

Pulp 14

Components of pulp 15

Vascularity of the pulp 16

Interstitial fluid pressure 16

Nerve impulses in pulp 16

Pulp–dentin complex regeneration: Biological cues 16

3. Pathophysiology of Pain

19

Odontogenic pain 19

Pre-endodontic pain 19

Reversible pulpitis 19

Irreversible pulpitis 20

Pulp necrosis 20

Periradicular inflammation (apical periodontitis) 21

Referred pain 22

Inter-appointment endodontic pain (flare-up) 22

Microbial and iatrogenic causes 23

Inflammatory events 24

Risk factors 24

Treatment 25

Post-endodontic pain

Non-odontogenic pain 26

4. Drugs used in Endodontics

30

Sedative–hypnotic drugs 30

Anesthetic agents 32

Non-narcotic/non-opioid analgesics 35

Opioid analgesics 36

Corticosteroids 37

Alternative analgesics (acupuncture) 39

Management of infection (antibiotics) 40

Antibiotic prophylaxis 43

Antibiotic use: Risk and precautions 44

Drug resistance 45

Injudicious use of antibiotics (antibioma) 45

Antiemetic drugs 46

Vitamins and mineral supplements 46

5. Diseases of Dental Pulp

48

Pulpal inflammation 48

Causes of pulp diseases 49

Physical 49

Chemical 51

Bacterial 51

Classification of pulp diseases 52

Hyperaemia 54

Pulpitis 55

Pulp degeneration 59

Pulp necrosis 60

6. Diseases of Periradicular Tissues

63

Definition 63

General features 63

Periradicular diseases of endodontic origin 66

Acute periradicular lesions 66

Chronic periradicular lesions 68

Periradicular lesion of non-odontogenic origin 74

7. Rationale of Endodontic Treatment

78

Inflammation 78

Components of inflammation 78

Cellular events 78

Vascular changes 80

Tissue changes 81

Zones of inflammatory reactions 82

Implications of residual infection before and after root canal treatment 83

Repair following endodontic treatment	84		
Endodontic infections and systemic reactions	86		
Endodontic treatment and allergic reactions	86		
Healing of sinus tract	86		
8. Endodontic Microbiology	90	11. Endodontic Instruments	150
Microbes in endodontic diseases	90	Standardization of endodontic instruments	150
Rare endodontic infections	92	Make of endodontic instrument	151
Microflora of root filled teeth	93	Evolution of nickel-titanium instruments	152
Extraradicular infections	94	Terms used with endodontic instruments	152
Microbial diagnostic techniques	95	Fracture of Ni-Ti instruments	153
Culture	95	Classification of instruments	154
Microscopic examination	95	Diagnostic instruments	154
Immunological methods	95	Exploring instruments	154
Molecular methods	96	Extirpating instruments	155
Microbial interactions in infected root canals	99	Shaping instruments	156
Host-microbe interactions	99	Obturing instruments	159
Interaction among micro-organisms	99	Miscellaneous rotary systems	176
Biofilm in endodontic infections	100	Clinical recommendations (Do's and Don'ts)	179
<i>Enterococcus faecalis</i> : Significance in endodontics	103	Newer rotary designs	179
Potential role of enterococci in unsuccessful root canal treatment	104	12. Sterilization of Endodontic Instruments	187
9. Diagnosis and Diagnostic Aids	108	Sterilization of operating room	187
Patient assessment	108	Sterilization of instruments	187
Clinical examination	110	Sterilization of handpiece and turbines	192
Extraoral examination	110	Sterilization of miscellaneous instruments	193
Intraoral examination	110	13. Anatomy of Pulp Spaces	195
Clinical inspection methods	112	Relationship of pulp chamber to clinical crown	196
Pulp vitality tests	115	Anatomy of apical-third of root canal	197
Tests assessing the neural status of pulp	116	Apical constriction	197
Tests assessing the blood supply of pulp	119	Cementodentinal junction	197
Radiographic techniques	121	Apical foramen	199
Conventional radiography	121	Anatomic complexities in root canal system	199
Radiovisiography	124	Radix entomolaris and radix paramolaris	199
Xeroradiography	125	C-shaped canals	200
Digital subtraction radiography	125	Accessory/lateral canals	202
Computed tomography (CT)	126	Apical delta	203
Magnetic resonance imaging (MRI)	127	Isthmus	203
Cone beam computed tomography (CBCT)	127	Root canal curvatures	203
C-arm imaging	132	Horizontal dimensions of root canal	205
Tests measuring tooth temperature	132	Classification of root canal anatomy	205
Newer methods	133	Weine's classification	205
Ultrasonic imaging	133	Vertucci classification	206
Computer expert system	134	Ahmed and Dummer classification	207
Laser optical disc storage	134	Configuration of pulp spaces in individual teeth	207
10. Endodontic Case Selection: Treatment Planning	138	Maxillary teeth	207
Endodontic treatment vs osseointegrated implants	138	Mandibular teeth	215
Case selection (treatment planning) in endodontics	139	Development anomalies and root canal system	225
		14. Access Cavity Preparation	232
		Basic principles of endodontic treatment	232
		Pain management	232
		Sterilization	232

Drainage-trephination 232		Carbamide peroxide (glyoxide) 294	
Immobilization 233		Maleic acid 294	
Isolation (rubber dam application) 233		Chelating agents 294	
Access cavity preparation 241		MTAD 295	
Objective of access cavity preparation 241		Tetraclean 296	
Rules for access cavity preparation 242		Bioactive glass 296	
Armamentarium for access cavity preparation 242		Electrochemically activated solutions 296	
Phases of access cavity preparation 243		Ozonated water 297	
Pre-endodontic build-up technique 245		Carisolv 297	
Conservative access cavity preparation 246		Photon-activated disinfection 297	
Cavity design for individual teeth 247		Herbal irrigants 297	
Maxillary anterior teeth 247		NanoCare plus 298	
Mandibular anterior teeth 251		Efficacy of Irrigants 299	
Access cavity preparation in difficult cases 254		Irrigating techniques 301	
15. Working Length and Working Width 256		Conventional technique 301	
Anatomy of the root apex 256		Sonic irrigation 302	
Apical terminus of root canal preparation and obturation 257		Ultrasonic irrigation 303	
Assessing apical constriction area 258		Negative pressure irrigation 304	
Types of apex locators 260		Irrivac needle pressure system 305	
Endodontic working width 266		VATEA self-adjusting file (SAF) system 305	
Need to enlarge apical constriction area 268		Intracanal aspiration technique 305	
16. Cleaning and Shaping of Root Canals 270		Complications during root canal irrigation 305	
Objectives of root canal preparation 270		Intracanal medicaments 308	
Instrument motions during root canal preparation 271		19. Root Canal Sealers 314	
Root canal preparation: Concepts/terms 272		Biophysical properties of root canal sealers 314	
Techniques of root canal preparation 273		Classification 316	
Apical-coronal techniques 273		Individual sealers 316	
Coronal-apical techniques 277		Zinc oxide-based sealers 316	
17. Endodontic Smear Layer 281		Medicated zinc oxide eugenol sealers 319	
Factors influencing formation of smear layer 282		Resin-based sealers 320	
Management of smear layer 282		Gutta-percha in organic solvents 324	
Removal of smear layer 283		Cements as sealers 324	
Mechanical removal 283		Silicone-based sealers 324	
Chemical removal 284		Calcium hydroxide-based sealers 325	
Ultrasonics 287		Bioceramic-based root canal sealers 327	
Lasers 287		Miscellaneous sealers 332	
18. Root Canal Irrigants and Medicaments 290		20. Obturation of Root Canal Spaces 335	
Requisites for an ideal irrigant 290		Apical termination of obturation 335	
Classification of irrigating solutions 290		Overfilling and overextension 336	
Commonly used irrigants 291		Materials used for obturation: Classification 336	
Normal saline 291		Gutta-percha 337	
Sodium hypochlorite 291		Silver cones 351	
Chlorhexidine 292		Miscellaneous obturating techniques 353	
QMix 293		Obturation of apical third area 357	
Hydrogen peroxide 293		Pastes as obturating materials 360	
Iodophors (iodine potassium iodide) 293		Retrograde (root end) filling materials 361	
Chlorine dioxide 294		21. Single-visit Endodontics 366	
		Indications and contraindications 370	
		Criteria for single visit endodontics 371	

22. Postendodontic Restorations	373	27. Root Resorption	489
Effect of root canal treatment on the tooth	373	Etiology	489
Selection of restoration for endodontically treated teeth	374	Pathogenesis	490
Tooth restorability index (TRI)	374	Classification	490
Classification guiding the choice of restoration	377	External resorption	491
Postcore restorations	378	External inflammatory resorption	491
Functions of post	379	External cervical resorption	492
Classification of post	379	External replacement resorption	494
Types of post	379	External surface resorption	495
Ferrule effect	389	External transient apical breakdown	495
Cores	401	External root resorption of non-dental origin	495
Restoration of teeth after root amputation	403	Internal resorption	496
		Internal inflammatory resorption	496
		Internal surface resorption	496
		Internal replacement resorption	497
		Internal transient apical breakdown	497
		Internal root resorption of non-dental origin	497
		Idiopathic root resorption	498
23. Endodontic Emergencies	409	28. Pediatric Endodontics	501
Classification	409	Differences in primary and permanent teeth	501
Pretreatment emergencies	410	Diagnosis	503
Mid-treatment emergencies	418	Pulp therapy	504
Post-treatment emergencies	420	Apexification/apexogenesis	517
		Use of antibiotics in pediatric endodontics	517
24. Bleaching of Discolored Teeth	422	29. Geriatric Endodontics	520
Tooth discoloration and staining	422	Changes due to ageing in oral-dental tissues	520
Bleaching of teeth	424	Endodontic treatment in elderly	521
Additional materials used during bleaching procedure	425	History and clinical examination	521
Techniques of nonvital in bleaching	432	Diagnosis	522
Adverse effects of bleaching	437	Treatment planning	523
		Preparation before endodontic treatment	523
		Endodontic procedures	523
		Challenges in treating elderly patients	524
		Management of root exposure	524
25. Vital Pulp Therapy	441	30. Magnification in Endodontics	527
Healthy pulp and primary trauma	441	Magnification types	527
Indirect pulp capping/indirect pulp treatment	443	Ergonomics	529
Direct pulp capping	446	Common terms used in magnification	530
Pulp curettage	450	Parts of the microscope	530
Partial pulpotomy	452	Magnification	530
Pulpotomy	454	Illumination	532
Apexogenesis (root formation)	455	Accessories	533
Apexification (root end closure)	456	Uses of operating microscope in endodontics	524
		Diagnosis	534
		Non-surgical endodontic procedures	534
		Surgical endodontics	536
		Documentation and patient education	538
		Marketing and practice management	538
26. Traumatic Injuries and Management	461		
Traumatic Dental Injuries: Types and nomenclature	461		
Classification	462		
Root fractures	465		
Cracked tooth syndrome	470		
Management of patient with dental trauma	473		
Management of soft tissue injuries	474		
Management of hard tissue injuries	475		
Healing of root fracture	481		
Storage medium	485		
Fracture of alveolar process	487		

31. Lasers in Endodontics	539	34. Endodontic–Periodontal Relationship	588
Principle of laser 539		Periodontal pulpal interrelationship 588	
Components of laser device 539		Classification of endodontic periodontal lesions 589	
Laser tissue interaction 541		Simon's/Cohen's classification 589	
Classification of laser 541		Grossman's classification 589	
Types of lasers 542		Weine's classification 590	
Application of lasers technology in endodontics 545		Diagnosis 591	
Laser hazards 551		Treatment 592	
Laser safety 551		Primary endodontic lesions 594	
32. Surgical Endodontics	553	Primary periodontal lesions 594	
Indications and contraindications 553		Combined lesions 594	
Classification of surgical endodontic procedures 553		35. Endodontic–Orthodontic Continuum	597
Preoperative assessment 554		Implications of orthodontic tooth movement 597	
Presurgical evaluations 554		Effect of orthodontic tooth movement on pulp 597	
Premedication 555		Orthodontic force and root resorption 598	
Preparation of the surgeon and the patient 555		Orthodontic tooth movement and periapical lesions 599	
Preparation of the surgical site 555		Endodontic surgery and orthodontic forces 599	
Local anaesthesia 555		Orthodontic extrusion (forced orthodontic eruption) 600	
Classification of local anesthetics 557		Orthodontic behaviour of endodontically treated teeth 601	
Techniques of regional anaesthesia 558		36. Endodontic Failure and Retreatment	603
Complications of anaesthesia 563		Basis of success and failure 603	
Advances in local anaesthesia 563		Causes of failure 603	
Failure of anaesthesia in endodontic procedures 564		Nonsurgical retreatment 605	
Principles of surgery 564		Indications and contraindications 605	
Suture materials 569		Objectives of retreatment 605	
Surgical needles 570		Treatment planning 605	
Closure of surgical sites 571		Management of endodontic failures 606	
Methods of suturing 572		Coronal leakage 606	
Surgical armamentarium 573		Inadequate root canal treatment 606	
Surgical procedures 574		Missed canals 615	
Osseous entry (osteotomy) 574		Canal blockage 615	
Apicoectomy (root-end resection) 574		Ledges 616	
Guided tissue regeneration (GTR) 576		Canal transportation 616	
Autotransplantation 578		Perforation 617	
Decompression of large periradicular lesions 578		37. Resinifying Therapy in Endodontics	621
Perforation repair 579		Utility of resinifying therapy 622	
Hemisection/bicuspidization/radisection 579		Resinifying agent as an obturating material 622	
Electrosurgery 580		Resinifying agent as a direct pulp capping material 624	
Cryosurgery 581		Resinifying agent as a sealer 624	
Postoperative care 581		Resinifying agent as a material for temporization 625	
33. Endodontic Implants	584	Resinifying agent in complications 625	
Indications 584			
Contraindications 584			
Patient selection 585			
Implant materials and designs 585			
Implant placement 587			

38. Regenerative Endodontics

627

- Important studies 627
- Tissue engineering 628
- Triad of tissue engineering 629
- Clinical applications of tissue engineering 632
- Limitations of regenerative procedures 637

39. Ethics in Endodontics

640

- Modern version of the Hippocratic oath
(revised in 1964 by Louis Lasagna) 641

- Ethical dilemmas 641
- Ethical principles 642
- Advertising in dentistry 644
- Standard of care 645
- Endodontic referrals 647
- Negligence and malpractice 647
- Ethics in endodontic research 649
- Laws in dentistry 650

Index

653