

Contents

Foreword *xix*

List of Contributors *xxi*

About the Companion Website *xxiii*

1 Introduction *1*

Christopher C.K. Ho

References *4*

2 Patient Assessment and History Taking *5*

Christopher C.K. Ho

2.1 Principles *5*

2.1.1 Medical History *5*

2.1.2 Medications and Allergies *6*

2.1.3 Past Medical History *6*

2.1.3.1 Cardiovascular Disorders *6*

2.1.3.2 Diabetes Mellitus *7*

2.1.4 Age *7*

2.1.5 Smoking *7*

2.1.6 Osteoporosis and Bisphosphonate Therapy *8*

2.1.7 Radiotherapy *9*

2.1.8 Dental History *9*

2.1.9 Social History *10*

2.2 Tips *10*

References *10*

3 Diagnostic Records *13*

Aodhan Docherty and Christopher C.K. Ho

3.1 Principles *13*

3.1.1 Diagnostic Imaging and Templates *13*

3.1.1.1 Three-Dimensional Imaging *14*

3.1.1.2 Templates *14*

3.1.2 Guided Surgery *16*

3.1.3 Diagnostic Records *17*

3.1.3.1 Articulated Study Models *17*

3.1.3.2 Photographic Records *18*

3.2	Procedures	18
3.2.1	Template Design	18
3.2.1.1	Traditional Templates	18
3.2.1.2	Digital Templates	18
3.2.2	Photography	19
3.3	Tips	23
	References	23
4	Medico-Legal Considerations and Risk Management	25
	<i>Christopher C.K. Ho</i>	
4.1	Principles	25
4.1.1	Informed Consent	25
4.2	Procedures	26
4.2.1	Dental Records	26
4.3	Tips	28
	Reference	28
5	Considerations for Implant Placement: Effects of Tooth Loss	29
	<i>Kyle D. Hogg</i>	
5.1	Principles	29
5.1.1	Local Site Effects of Tooth Loss	29
5.1.2	Effects of Tooth Loss on the Individual Level	32
5.1.3	Effects of Tooth Loss on the Population Level	32
5.2	Procedures	33
5.3	Tips	34
	References	34
6	Anatomic and Biological Principles for Implant Placement	37
	<i>Kyle D. Hogg</i>	
6.1	Principles	37
6.1.1	Osteology	37
6.1.2	Innervation and Vascular Supply	40
6.1.3	Musculature	41
6.2	Procedures	41
6.3	Tips	47
	References	47
7	Maxillary Anatomical Structures	49
	<i>Kyle D. Hogg</i>	
7.1	Principles	49
7.2	Maxillary Incisive Foramen and Canal	49
7.2.1	Importance in Oral Implantology	50
7.3	Nasal Cavity	50
7.3.1	Importance in Oral Implantology	51
7.4	Infraorbital Foramen	52
7.4.1	Importance in Oral Implantology	52

7.5	Maxillary Sinus	52
7.5.1	Importance in Oral Implantology	54
7.6	Greater Palatine Artery and Nerve	55
7.6.1	Importance in Oral Implantology	55
	References	56
8	Mandibular Anatomical Structures	59
	<i>Kyle D. Hogg</i>	
8.1	Principles	59
8.2	Mental Foramen and Nerve	59
8.2.1	Importance in Oral Implantology	61
8.3	Mandibular Incisive Canal and Nerve	62
8.3.1	Importance in Oral Implantology	62
8.4	Genial Tubercles	63
8.4.1	Importance in Oral Implantology	63
8.5	Lingual Foramen and Accessory Lingual Foramina	63
8.5.1	Importance in Oral Implantology	63
8.6	Sublingual Fossa	64
8.6.1	Importance in Oral Implantology	65
8.7	Submental and Sublingual Arteries	65
8.7.1	Importance in Oral Implantology	65
8.8	Inferior Alveolar Canal and Nerve	65
8.8.1	Importance in Oral Implantology	67
8.9	Lingual and Mylohyoid Nerves	67
8.9.1	Importance in Oral Implantology	68
8.10	Submandibular Fossa	68
8.10.1	Importance in Oral Implantology	69
8.11	Mandibular Ramus	69
8.11.1	Importance in Oral Implantology	69
	References	69
9	Extraction Ridge Management	73
	<i>Tino Mercado</i>	
9.1	Principles	73
9.2	Osteoconductive Materials for Ridge Management	74
9.3	Biologically Active Materials for Ridge Management	74
9.4	Influence of Buccal Wall Thickness on Ridge Management	82
	References	82
10	Implant Materials, Designs, and Surfaces	87
	<i>Jonathan Du Toit</i>	
10.1	Principles	87
10.2	Implant Bulk Materials	87
10.2.1	Pure Titanium Used for Implant Bulk Material	88
10.2.2	Titanium Alloys Used for Implant Bulk Material	90
10.2.3	Zirconia Used for Implant Bulk Material	90

10.2.4	Other Materials as Bulk Implant Material	92
10.3	Implant Surface Treatments	92
10.4	Implant Design	95
10.4.1	Implant Body Shape Design	95
10.4.2	Implant Thread Design	96
10.4.3	Implant Connection Designs	96
10.4.4	Which Implant Connections Are Better and Why?	98
10.5	Summary	101
	References	101

11 Timing of Implant Placement 103

Christopher C.K. Ho

11.1	Principles	103
11.1.1	Classification for Timing of Implant Placement	103
11.1.2	Immediate Placement	104
11.1.3	Delayed Implant Placement	107
11.1.3.1	Resolution of Local Infection	107
11.1.3.2	Dimensional Changes of the Alveolar Ridge	107
11.2	Procedures	108
11.2.1	Systemic Risk Factors	108
11.2.2	Local Risk Factors	108
11.2.3	Biomaterials	109
11.2.4	Socket Morphology	110
11.2.5	Flapless Protocol	111
11.2.6	Clinician Experience	112
11.2.7	Adjunctive Procedures with Implant Placement	112
11.2.7.1	Simultaneous Bone Augmentation with Implant Placement	112
11.2.7.2	Adjunctive Soft Tissue Grafting	112
11.2.8	Selecting the Appropriate Treatment Protocol	113
11.3	Tips	114
	References	114

12 Implant Site Preparation 117

Tom Giblin

12.1	Principles	117
12.2	Assessing Implant Sites and Adjacent Teeth	118
12.2.1	Periodontal Charting	118
12.2.2	Assessment of Gingival Biotype and Attached Mucosa	118
12.2.3	Photography	118
12.2.4	Aesthetic Assessment	119
12.2.5	Radiography	119
12.2.6	Occlusal Analysis	120
12.2.7	Endodontic Status of Adjacent Teeth	120
12.3	Site Preparation	120
12.3.1	Grafting – Sinus, Buccal, Soft Tissue	121

- 12.3.2 Occlusion 121
- 12.3.3 Adjacent and Opposing Teeth 121
- 12.3.4 Crown Lengthening and Gingivectomy 122
- 12.3.5 Orthodontics and Site Preparation 122
- 12.3.6 Provisional Phase 124
- References 126
- Further Reading 126

13 Loading Protocols in Implantology 129

Christopher C.K. Ho

- 13.1 Principles 129
 - 13.1.1 Definitions 129
 - 13.1.2 Conventional Loading 130
 - 13.1.3 Early Loading 130
 - 13.1.4 Progressive Loading 130
 - 13.1.5 Immediate Loading 130
- 13.2 Procedures 131
 - 13.2.1 Selecting a Loading Protocol 131
 - 13.2.2 Methods of Evaluation of the Primary Stability for Immediate Loading 134
- 13.3 Tips 134
- References 135

14 Surgical Instrumentation 137

Christopher C.K. Ho

- 14.1 Principles 137
 - 14.1.1 Mirror, Probe, and Tweezers 137
 - 14.1.2 Scalpel Handles 137
 - 14.1.3 Scalpel Blades 138
 - 14.1.4 Curettes 138
 - 14.1.5 Needle Holders 138
 - 14.1.6 Periosteal Elevators 139
 - 14.1.7 Retractors 139
 - 14.1.8 Depth Probe 139
 - 14.1.9 Tissue Forceps/Pliers 139
 - 14.1.10 Mouth Props/Bite Blocks 140
 - 14.1.11 Scissors 140
 - 14.1.12 Extraction Forceps, Periotomes and Elevators 140
 - 14.1.13 Kidney Dish 140
 - 14.1.14 Surgical Kit, Electric Motor, 20:1 Handpiece, and Consumables 140
 - 14.1.15 Grafting Well 141
- 14.2 Optional Instrumentation 141
 - 14.2.1 Rongeurs 141
 - 14.2.2 Benex 141
 - 14.2.3 Bone Harvesters 142

14.2.4	Anthogyr Torq Control	142
14.2.5	Piezosurgery	143
14.3	Tips	144
15	Flap Design and Management for Implant Placement	145
	<i>Christopher C.K. Ho, David Attia, and Jess Liu</i>	
15.1	Principles	145
15.1.1	Neurovascular Supply to Implant Site	145
15.1.2	Flap Design and Management	146
15.1.3	Types of Flap Reflection	146
15.2	Procedures	148
15.2.1	Tissue Punch	148
15.2.2	Envelope Flap	148
15.2.3	Triangular (Two-Sided) and Trapezoidal (Three-Sided) Flap	150
15.2.4	Papilla-Sparing Flap	151
15.2.5	Buccal Roll	152
15.2.6	Palacci Flap	152
15.3	Tips	152
	References	154
16	Suturing Techniques	155
	<i>Christopher C.K. Ho, David Attia, and Jess Liu</i>	
16.1	Principles	155
16.1.1	Types of Sutures	155
16.1.1.1	Absorbable Sutures	156
16.1.1.2	Non-absorbable Sutures	156
16.1.2	Suture Adjuncts	157
16.1.3	Suture Size	157
16.1.4	Needle	157
16.2	Procedures	158
16.2.1	Simple/Interrupted Sutures	158
16.2.2	Continuous/Uninterrupted Suture	159
16.2.3	Mattress Sutures	159
16.2.3.1	Horizontal Mattress	161
16.2.3.2	Vertical Mattress	161
16.2.4	Suture Removal	162
16.3	Tips	162
17	Pre-surgical Tissue Evaluation and Considerations in Aesthetic Implant Dentistry	163
	<i>Sherif Said</i>	
17.1	Principles	163
17.2	The Influence of Tissue Volume on Peri-implant 'Pink' Aesthetics	163
17.3	Tissue Volume Availability and Requirements	165
17.3.1	Hard Tissue Requirements	165

- 17.3.2 Soft Tissue Requirements 166
- 17.4 Pre-operative Implant Site Assessment 166
- 17.5 Key Factors in Diagnosis of the Surrounding Tooth Support Prior to Extraction 167
- 17.5.1 Integrity of the Interproximal Height of Bone 168
- 17.5.2 Essential Criteria Evaluation Prior to Extraction 168
- 17.5.3 Integrity of the Buccal Plate of Bone 169
- 17.6 Tips 169
- 17.7 Conclusion 170
- References 170

18 Surgical Protocols for Implant Placement 173

Christopher C.K. Ho

- 18.1 Principles 173
- 18.1.1 Implant Positioning 174
- 18.2 Procedures 176
- 18.2.1 One-Stage versus Two-Stage Protocols 177
- 18.2.2 Post-operative Management Protocols 177
- 18.3 Tips 179
- References 179

19 Optimising the Peri-implant Emergence Profile 181

David Attia and Jess Liu

- 19.1 Principles 181
- 19.1.1 The Peri-implant Emergence Profile 181
- 19.2 Procedures 182
- 19.2.1 Single-Stage versus Two-Stage Implant Surgery 182
- 19.2.2 Buccal Roll Flap 183
- 19.2.3 Pouch Roll Technique 186
- 19.2.4 Apically Repositioned Flap 188
- 19.2.5 Buccally Repositioned Flap 191
- 19.2.6 Free Gingival Graft 193
- 19.3 Tips 196
- References 198

20 Soft Tissue Augmentation 199

Michel Azer

- 20.1 Principles 199
- 20.1.1 Types of Oral Soft Tissue 199
- 20.1.2 Anatomical Considerations for Harvesting Autogenous Soft Tissue Grafts 200
- 20.1.2.1 Hard Palate 200
- 20.1.2.2 Tuberosity 200
- 20.1.2.3 Buccal Attached Gingiva of Maxillary Molars 201
- 20.1.3 Soft Tissue Substitutes 201

20.1.3.1	Allogenic Origin	201
20.1.3.2	Xenograft Origin	201
20.1.4	Purpose of Soft Tissue Graft (Periodontal Plastic Surgery)	201
20.1.4.1	Aesthetic Purpose	201
20.1.4.2	Functional Purpose	201
20.2	Procedures	201
20.2.1	Techniques	201
20.2.1.1	Harvesting the Palatal Tissue Graft as a Free Gingival Graft and Connective Tissue Graft	201
20.2.1.2	Root Coverage	202
20.2.1.3	Soft Tissue Augmentation Prior to Bone Grafting	202
20.2.1.4	Soft Tissue Graft to Gain Keratinised Tissue	203
20.3	Tips	209
	References	209
	Further Reading	210

21 Bone Augmentation Procedures 211

Michel Azer

21.1	Principles	211
21.1.1	Why is Bone Grafting Necessary?	211
21.1.2	Defect Topography Classification	211
21.1.3	Requirements for Successful Tissue Grafting	212
21.1.4	Materials Used for Augmentation	212
21.1.4.1	Autogenous Bone	212
21.1.4.2	Membranes	212
21.1.4.3	Membrane Fixation Systems	213
21.2	Procedures	213
21.2.1	Bone Graft with Non-resorbable Membrane	213
21.2.2	Autogenous Bone Graft	215
21.3	Tips	217
	References	217

22 Impression Taking in Implant Dentistry 219

Christopher C.K. Ho

22.1	Principles	219
22.1.1	Impression Techniques Used in Implant Dentistry	220
22.1.1.1	Abutment Level Impressions	220
22.1.1.2	Implant Level Impressions	220
22.1.2	Customised Impression Copings	222
22.1.3	Multiple Unit Impressions	222
22.2	Procedures	224
22.2.1	Implant Level Impression	224
22.2.2	Digital Impressions	225

22.3	Tips	225
	References	226
23	Implant Treatment in the Aesthetic Zone	227
	<i>Christopher C.K. Ho</i>	
23.1	Principles	227
23.1.1	General Considerations	227
23.1.1.1	Lip Contour and Length	228
23.1.1.2	Tooth Display at Repose and in Broad Smile	228
23.1.1.3	Smile Line	228
23.1.1.4	Teeth Length, Shape, Alignment, Contour, and Colour	229
23.1.1.5	Gingival Display, Gingival Zeniths, and Papillae of Maxillary Anterior Teeth	229
23.1.1.6	Width of Edentulous Space	230
23.1.1.7	Gingival Biotype	230
23.1.2	Major Deficiencies in Hard and Soft Tissues	230
23.2	Procedures	232
23.2.1	Assessment of Gingival Biotype	232
23.2.2	Clinical Management	232
23.2.3	Timing of Implant Placement	233
23.2.4	Thickness of Soft Tissues	234
23.3	Tips	234
	References	235
24	The Use of Provisionalisation in Implantology	237
	<i>Christopher C.K. Ho</i>	
24.1	Principles	237
24.1.1	Prosthetically Guided Tissue Healing	237
24.2	Procedures	240
24.2.1	Direct Techniques	240
24.2.2	Indirect Techniques	240
24.3	Tips	241
	Reference	242
25	Abutment Selection	243
	<i>Christopher C.K. Ho</i>	
25.1	Principles	243
25.1.1	Custom Abutments	245
25.1.2	Prefabricated (Stock) Abutments	245
25.1.3	Material Selection	247
25.1.4	Abutment Design	249
25.2	Procedures	250
25.3	Tips	250
	References	251

26 Screw versus Cemented Implant-Supported Restorations 253*Christopher C.K. Ho*

- 26.1 Principles 253
- 26.1.1 Retrievability 253
- 26.1.2 Aesthetics 254
- 26.1.3 Passivity 254
- 26.1.4 Hygiene (Emergence Profile) 255
- 26.1.5 Reduced Occlusal Material Fracture 255
- 26.1.6 Inter-arch Space 256
- 26.1.7 Occlusion 256
- 26.1.8 Health of Peri-Implant Tissue 256
- 26.1.9 Provisionalisation 256
- 26.1.10 Clinical Performance 256
- 26.2 Procedures 257
- 26.2.1 Screw-Retained Restoration 257
- 26.2.2 Cement-Retained Restoration 260
- 26.2.3 Lateral Set-Screw (Cross-Pinning) 261
- 26.2.4 Angle Screw Correction/Bi-axial Screws 262
- 26.3 Tips 263
- References 264

27 A Laboratory Perspective on Implant Dentistry 265*Lachlan Thompson*

- 27.1 The Shift from Analogue to Digital 265
- 27.2 Standards in Manufacturing Today 265
- 27.3 The Importance of Implant Planning for the Laboratory 267
- 27.4 Digital Planning to Manage Aesthetic Cases 268
- 27.5 Scanning for Implant Restorations 268
- 27.6 Digital Data Acquisition for Full Arch Cases 271
- 27.7 Inserting Full Arch Cases at Surgery 272
- 27.8 Tips 275

28 Implant Biomechanics 277*Tom Giblin*

- 28.1 Principles 277
- 28.1.1 Forces and their Nature 277
- 28.1.1.1 $\text{Pressure} = \text{Force}/\text{Area}$ 278
- 28.1.1.2 $\text{Impulse} = \text{Force}/\text{Time}$ 278
- 28.1.1.3 Compressive, Tensile, and Shear Forces 279
- 28.1.1.4 Application to Materials and Occlusion 279
- 28.1.1.5 Incline Plane Mechanics (Normal Force) 280
- 28.1.2 Beams 280
- 28.1.3 Levers 281
- 28.1.4 Cantilevers 282
- 28.1.5 Bone 283
- Reference 285
- Further Reading 285

29	Delivering the Definitive Prosthesis	289
	<i>Aodhan Docherty and Christopher C.K. Ho</i>	
29.1	Principles	289
29.1.1	Soft Tissue Support	289
29.1.2	Occlusal Verification	290
29.1.3	Aesthetic Evaluation	290
29.1.4	Torque Requirement for Delivery	292
29.1.5	Cementation Technique and Material Selection – Cemented Crowns	292
29.1.6	Screw Access Channel Management – Screw-Retained Crowns	294
29.1.7	Pink Porcelain	295
29.2	Procedures	296
29.2.1	Delivering a Cement-Retained Crown – Chairside Copy Abutment Technique	296
29.2.1.1	Creating a Polyvinyl Siloxane Copy Abutment	296
29.2.1.2	Delivering a Cement-Retained Crown Using a Copy Abutment Technique	296
29.3	Tips	298
	References	298
30	Occlusion and Implants	299
	<i>Christopher C.K. Ho and Subir Banerji</i>	
30.1	Principles	299
30.1.1	Excessive Forces on Dental Implants	301
30.1.2	Bruxism and Implants	301
30.2	Procedures	302
30.2.1	Clinical Occlusal Applications	303
30.3	Tips	305
	References	305
31	Dental Implant Screw Mechanics	307
	<i>Christopher C.K. Ho and Louis Kei</i>	
31.1	Principles	307
31.1.1	Factors Affecting Implant Screw Joint Stability	308
31.1.1.1	Preload	308
31.1.1.2	Embedment Relaxation (Settling Effect)	308
31.1.1.3	Screw Material and Coating	308
31.1.1.4	Screw Design	309
31.1.1.5	Abutment/Implant Interface Misfit	309
31.1.1.6	Abutment/Implant Interface Design	309
31.1.1.7	Functional Forces	310
31.1.1.8	Number of Implants	310
31.1.1.9	Torque Wrench	310
31.2	Procedures	311
31.2.1	Techniques for Retrieving a Fractured Screw	311
31.2.1.1	The Ultrasonic Scaler Technique	311

31.2.1.2	Screwdriver Technique	312
31.2.1.3	Manufacturer Rescue Kits	312
31.3	Tips	312
	References	313
32	Prosthodontic Rehabilitation for the Fully Edentulous Patient	315
	<i>Christopher C.K. Ho</i>	
32.1	Principles	315
32.1.1	Number of Implants for Full Arch Implant Rehabilitation	317
32.1.1.1	Removable Overdenture	317
32.1.2	Fixed Implant-Supported Bridgework	319
32.2	Procedures	320
32.2.1	Occlusal Vertical Dimension	320
32.2.2	Phonetics	321
32.2.3	Swallowing	322
32.2.4	Facial Appearance	322
32.2.5	Impression Taking	322
32.2.6	Abutment Selection	322
32.2.7	Prosthodontic Options for Fixed Bridgework	323
32.2.8	Occlusion	323
32.3	Tips	323
	References	326
33	Implant Maintenance	327
	<i>Kyle D. Hogg and Christopher C.K. Ho</i>	
33.1	Principles	327
33.1.1	Radiographic Analysis	328
33.2	Procedures	330
33.3	Tips	333
	References	333
34	The Digital Workflow in Implant Dentistry	335
	<i>Andrew Chio and Anthony Mak</i>	
34.1	Components and Steps of the Digital Implant Workflow	336
34.1.1	Digital Diagnostic Impression	336
34.1.2	Cone Beam Computed Tomography	337
34.1.3	Digital Implant Treatment Planning	337
34.1.4	The Digital Surgical Guide	338
34.1.5	Pre-surgical Fabricated Temporary Prosthesis	342
34.1.6	Guided Implant Surgery	342
34.1.7	Implant Digital Impressions	343
34.1.8	Manufacturing of the Customised Prosthesis	343
	References	347
35	Biological Complications	351
	<i>Christopher C.K. Ho</i>	
35.1	Principles	351
35.1.1	Attachment Differences	352

35.1.2	Crestal Bone Loss	353
35.1.3	Peri-implant Disease	353
35.1.3.1	Prevalence of Peri-implant Diseases	354
35.1.3.2	Risk Factors in Peri-implant Disease	354
35.2	Procedures	357
35.2.1	Treatment of Peri-implant Disease	357
35.2.1.1	Methods of Decontamination	358
35.2.2	Treatment of Peri-implant Mucositis	360
35.2.3	Treatment of Peri-implantitis	361
35.2.3.1	Non-surgical Therapy for Peri-implantitis	361
35.2.3.2	Surgical Therapy for Peri-implantitis	361
35.2.4	Recommendations	364
35.2.5	Supportive Care	365
35.3	Tips	366
	References	367
36	Implant Prosthetic Complications	371
	<i>Christopher C.K. Ho and Matthew K. Youssef</i>	
36.1	Principles	371
36.1.1	Incidence of Prosthetic Complications	372
36.1.1.1	Implant-Supported Single Tooth Crowns and Implant-Fixed Dental Prostheses	372
36.1.1.2	Full Arch Implant-Fixed Dental Prostheses	373
36.1.2	Aetiology of Prosthetic Complications	374
36.1.2.1	Mechanical Overloading	374
36.1.2.2	Cement Excess	374
36.1.2.3	Proximal Contact Loss	374
36.2	Procedures	374
36.2.1	Occlusion	374
36.2.2	Unfavourable Implant Position	375
36.2.3	Anterior Implants	375
36.2.4	Implant Fracture	375
36.2.5	Screw Loosening	377
36.2.6	Abutment Screw Fracture	377
36.2.7	Stripped Screw Head	377
36.2.8	Passive Fit	378
36.2.9	Mechanical and Biological Complications of Framework Misfit	380
36.2.10	Impression Technique	381
36.2.11	Gingival Fistula	381
36.2.12	Prevention of Prosthetic Complications	382
36.3	Tips	383
	References	383
	Index	387

