

Table of Contents

1	Introduction	1
	<i>G. Gallucci</i>	
1.1	Acquiring Digital Data	3
1.2	Manipulating Digital Data	4
2	Surface Scans	7
	<i>C. Evans</i>	
2.1	Introduction.....	8
2.2	Analog Impressions	10
2.2.1	Material Accuracy	10
2.2.2	Patient Comfort	10
2.2.3	Cast Production	11
2.3	Digital “Impressions”—Digitization of the Oral Cavity.....	12
2.3.1	File Formats	12
2.3.2	Extraoral Scanning Systems	13
2.3.3	Impression Scanning.....	14
2.3.4	Intraoral Scanning Systems.....	14
2.3.5	Emergence-Profile Scans.....	16
2.4	Accuracy: Trueness and Precision	17
2.4.1	Technique Selection	18
2.5	The Need for Physical Models	19
2.6	Concluding Remarks.....	20
3	Facial Scanning	21
	<i>A. Tahmaseb, B. Hassan</i>	
3.1	Technological Evolution	23
3.2	Technological Principles of Contemporary Facial Scanning.....	24

3.3	Applications in Prosthetic Dentistry.....	27
3.4	Clinical Case	29
3.5	Dynamic Facial Scanners.....	32
3.6	Shortcomings and Future Technical Improvements	33
3.7	Conclusions	34
4	Software Packages	35
	<i>C. Evans</i>	
4.1	Diagnostics and Data Collection	37
4.2	Prosthetic and Surgical Planning.....	39
4.2.1	Stock Tooth Shapes.....	40
4.2.2	Custom CAD.....	40
4.2.3	Importing a Clinical Tooth Position from a Diagnostic Set-Up.....	41
4.3	Computer-Assisted Design (CAD)	43
4.3.1	Final Prosthetic Design	43
4.3.2	Model-Building.....	49
4.4	Computer-Assisted Manufacturing (CAM).....	50
4.5	Concluding Remarks.....	51
5	Merging Digital Datasets.....	53
	<i>G.O. Gallucci, B. Friedland, A. Hamilton</i>	
5.1	Scanning Technologies and Related Datasets.....	55
5.2	Accuracy of CBCT Scans	57
5.3	Field of View (FoV)	58
5.4	Beam Hardening and Scatter	59
5.5	Preparation a Patient for a CBCT Scan	60
5.6	Merging Files	61
5.6.1	Merging Datasets Using Common Anatomical Structures.....	61
5.6.2	Merging Additional STL Files	63
5.6.3	Merging Datasets Using Radiographic Markers.....	63

6	Digital Workflows in Implant Prosthodontics.....	65
	<i>G. Gallucci</i>	
6.1	Digital Workflows Applied to Patient Care	68
6.2	Diagnostic Steps of the Digital Workflow	69
6.3	Planning Steps of the Digital Workflow.....	70
6.4	Surgical Steps of the Digital Workflow	71
6.5	Prosthodontic Steps of the Digital Workflow	72
6.6	Alternative Steps in Digital Workflows	75
7	Computer-Guided Surgery.....	77
	<i>A. Tahmaseb</i>	
7.1	Terminology	79
7.2	Systems Used in Guided Surgery.....	80
7.2.1	Dynamic Systems: Navigated Surgery.....	80
7.2.2	Static Systems: Guided Surgery	81
7.2.3	System Precision	83
7.3	Positioning the Surgical Guide	84
7.3.1	Bone-Supported Surgical Guides.....	84
7.3.2	Tooth-Supported Surgical Guides	84
7.3.3	Mucosa-Supported Surgical Guides.....	85
7.3.4	Fixture-Supported Surgical Guides.....	85
7.4	Prefabrication of Prostheses and Immediate Loading	87
7.5	Limitations	88
7.6	Future Developments.....	89
8	CAD/CAM Technology and Custom Bone Grafts.....	91
	<i>A. Tahmaseb, G. Ragoobar, N. Al-Harbi</i>	
8.1	Milled Bone-Graft Materials	93
8.2	Printed Bone-Graft Materials	95
8.3	Full 3D Planning of Free Vascularized Fibula Flaps for Maxillofacial Defects	96

9	Digital Articulators	97
	<i>C. Evans</i>	
9.1	Introduction.....	98
9.2	Mechanical Articulators.....	99
9.3	Digital Articulators	100
9.3.1	Mechanical Articulation with a Digital Interface	100
9.3.2	Simple Digital Articulation.....	101
9.3.3	Virtual Articulators.....	101
9.4	Possible Future Developments.....	103
10	Fabrication Techniques and Materials.....	105
	<i>C. Evans</i>	
10.1	Fabrication Techniques and Restorative Materials.....	107
10.2	Metal Alloys	109
10.2.1	Material Selection at the Abutment Level	109
10.2.2	Material Selection at the Framework Level	112
10.3	Zirconia	117
10.3.1	Material Selection at the Abutment Level	118
10.3.2	Material Selection at the Framework Level	121
10.4	Lithium Disilicate	123
11	Complications and Technical Challenges.....	125
	<i>C. Evans</i>	
11.1	Scanning-Related Complications.....	127
11.2	Software-Integration Complications.....	129
11.3	Milling Complications.....	133
12	Future Developments and Challenges	135
	<i>A. Tahmaseb, D. Wismeijer</i>	
13	Clinical Case Presentations: Implant-Supported Restorations Using Guided Surgery and CAD/CAM in a Digital Workflow	141

13.1	Replacing a Mandibular Second Premolar with a Chairside-Fabricated Crown	142
	<i>T. Joda</i>	
13.2	Replacing a Mandibular First Molar with a Crown Following Soft-Tissue Modeling	151
	<i>A. Kökat</i>	
13.3	Immediate Loading of a Premolar Implant with a Provisional Restoration	157
	<i>C. Fijnheer</i>	
13.4	Replacing a Mandibular Second Premolar with a Chairside-Fabricated Crown	163
	<i>A. Hamilton, A. De Souza, S. Doliveux</i>	
13.5	Replacing Four Upper Incisors with a Screw-Retained Bridge on Two Implants.....	177
	<i>K. Chmielewski, B. Roland</i>	
13.6	Replacing Three Mandibular Posterior Teeth with an Immediately Loaded Fixed Dental Prosthesis.....	195
	<i>W. D. C. Derksen</i>	
13.7	Replacing a Mandibular Denture with a Full-Arch Implant-Supported Mandibular Fixed Dental Prosthesis.....	203
	<i>P. Papaspyridakos</i>	
13.8	Rehabilitating an Edentulous Maxilla with Three Separate Bridges	211
	<i>G. Finelle</i>	
13.9	Rehabilitating an Edentulous Maxilla with a Fixed Dental Prosthesis Following Provisional Immediate Loading.....	222
	<i>A. Lanis, O. Álvarez</i>	
13.10	Oral Rehabilitation Aided by Digital Dentistry: Immediate Functional Loading with a Prefabricated Provisional Restoration.....	235
	<i>A. Lanis</i>	
13.11	Rehabilitating an Edentulous Maxilla with a Conventional Removable Denture and an Edentulous Mandible with a Fixed Dental Prosthesis Using s-CAIS	251
	<i>W.-S. Lin, W. Polido, J. R. Charette, D. Morton</i>	
13.12	Rehabilitating an Edentulous Maxilla with a Fixed Dental Prosthesis Using a DSD-Guided Approach.....	262
	<i>N. Sesma, W. Polido</i>	
13.13	Rehabilitating a Maxillofacial Defect with Transplanted Free Vascularized Fibula Segments and a Full-Arch Fixed Dental Prosthesis	274
	<i>G. Raghoobar, R. Schepers, A. Vissink, M. Witjes</i>	
14	Technical and Clinical Recommendations	281
	<i>C. Evans, G. O. Gallucci, A. Tahmaseb</i>	
15	References	285