Contents

Preface xv
Dedication xvii
Acknowledgements xviii

PART I CONCEPTS

Chapter 1 Facial Beauty
Definition of beauty and aesthetics 3
Is beauty ‘in the eye of the beholder’? 3
The enigma of facial beauty: Why is one face seen as beautiful and another as unattractive? What guides and validates our judgement? 4
‘Ideal’ proportions 5
Symmetry 6
Averageness 6
Facial neoteny 7
Sexual dimorphism (secondary sexual characteristics) 7
Heredity 7
Cultural influences on the perception of facial beauty 7
Facial beauty: historical and philosophical perspectives 9
Facial beauty: scientific perspectives 13
Importance of facial beauty 14
Self-image and negative self-perception 15

Chapter 2 Facial Proportions: Classical Canons to Modern Craniofacial Anthropometry
Introduction 18
Ancient Egypt 18
Ancient Greece 19
The Archaic Period 19
The Classical Period 21
The Roman conquest of Greece 25
Ancient Rome 26
The Renaissance 27
Leon Battista Alberti 28
Leonardo da Vinci 29
Albrecht Dürer 36
The Enlightenment and neoclassicism 38
Neoclassical canons of proportion 38
Craniometry 39
Twentieth century 41
Modern craniofacial anthropometry 41
Leslie Farkas – the father of modern craniofacial anthropology 42
The golden proportion 43
The ongoing problem with research into the golden proportion 44
Conclusion 44
References 44
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Section</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3</strong></td>
<td>Facial Expression: Influence and Significance</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>Introduction</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>Importance of facial expressions</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>History of research into facial expressions</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>The work of Duchenne</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>The work of Darwin</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>The work of Ekman</td>
<td>49</td>
</tr>
<tr>
<td></td>
<td>The debate: Are facial expressions of emotion universal or culture-specific?</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>References</td>
<td>52</td>
</tr>
<tr>
<td><strong>4</strong></td>
<td>Psychological Ramifications of Facial Deformities</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>Introduction</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>Health and psychosocial well-being</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>Self-image</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>The effect of the response of others on those with facial deformities</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>Teasing and bullying</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>To treat or not to treat? The controversial debate</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>Body dysmorphic disorder: the delusion of deformity</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>Body dysmorphic disorder</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td>Conclusion</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>References</td>
<td>61</td>
</tr>
</tbody>
</table>

**PART II** CLINICAL DIAGNOSIS

**SECTION 1** Patient Interview and Clinical Diagnostic Records

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Section</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Introduction to Section 1</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>Diagnosis</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>Terms of direction, position and movement</td>
<td>65</td>
</tr>
<tr>
<td><strong>5</strong></td>
<td>Patient Interview and Consultation</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>Introduction</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>Presenting complaint</td>
<td>67</td>
</tr>
<tr>
<td><strong>6</strong></td>
<td>Clinical Diagnostic Records, Natural Head Position and Craniofacial Anthropometry</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td>Introduction</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td>Clinical diagnostic records</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td>Radiographs</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td>Clinical photographs</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td>Study models</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td>Serial height measurement</td>
<td>74</td>
</tr>
<tr>
<td></td>
<td>Three-dimensional hard and soft tissue imaging</td>
<td>74</td>
</tr>
<tr>
<td></td>
<td>Natural head position</td>
<td>74</td>
</tr>
<tr>
<td></td>
<td>The Frankfort Craniometric Agreement and the Frankfort Plane</td>
<td>74</td>
</tr>
<tr>
<td></td>
<td>The unreliability of anatomical reference planes</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>Natural head position: the key to diagnosis</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td>Choice of horizontal and vertical reference planes</td>
<td>77</td>
</tr>
<tr>
<td></td>
<td>Orientation of the patient in natural head position</td>
<td>78</td>
</tr>
<tr>
<td></td>
<td>The self-balance position</td>
<td>78</td>
</tr>
<tr>
<td></td>
<td>The mirror position</td>
<td>78</td>
</tr>
<tr>
<td></td>
<td>The aesthetic position (or ‘photographic position’ of the head)</td>
<td>78</td>
</tr>
<tr>
<td></td>
<td>Clinical photography</td>
<td>79</td>
</tr>
<tr>
<td></td>
<td>Equipment for digital photography and data storage</td>
<td>79</td>
</tr>
<tr>
<td></td>
<td>Patient consent forms</td>
<td>79</td>
</tr>
<tr>
<td></td>
<td>Background and lighting</td>
<td>79</td>
</tr>
<tr>
<td></td>
<td>Facial views</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>Intraoral views</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>Craniofacial anthropometry</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td>Anthropometric craniofacial surface landmarks</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td>References</td>
<td>85</td>
</tr>
<tr>
<td><strong>7</strong></td>
<td>Cephalometry and Cephalometric Analysis</td>
<td>86</td>
</tr>
<tr>
<td></td>
<td>Introduction</td>
<td>86</td>
</tr>
<tr>
<td></td>
<td>Cephalometric landmarks and planes of reference</td>
<td>87</td>
</tr>
<tr>
<td></td>
<td>Landmarks, lines, planes and volumes</td>
<td>87</td>
</tr>
<tr>
<td></td>
<td>Hard tissue lateral cephalometric (skeletal) landmarks</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td>Hard tissue lateral cephalometric (dental) landmarks</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>Soft tissue lateral cephalometric landmarks</td>
<td>91</td>
</tr>
</tbody>
</table>
**Contents**

Cephalometric planes of reference 92
- Hard tissue lateral cephalometric reference planes 93
- Soft tissue lateral cephalometric reference planes 95

Posteroanterior cephalometric radiography 95
- Hard tissue posteroanterior cephalometric landmarks 96
- Hard tissue posteroanterior cephalometric reference planes 97

Cephalometric analysis and geometric principles 98

Description of dentofacial deformities 98

Sagittal skeletal relationships 100
- Sagittal positional relationships 100
- Size relationships of maxilla and mandible 108

Sagittal dentoalveolar relationships 110
- Inclination of the maxillary incisors 110
- Sagittal position of the maxillary incisors 112
- Inclination of the mandibular incisors 113
- Sagittal position of the mandibular incisors 114
- Inclination of maxillarly to mandibular incisors 115

Vertical skeletal relationships 115
- Convergence of horizontal facial planes (Sassouni analysis) 116
- Anterior and posterior face height 116
- Linear cephalometric measurements and normative values 119
- Angular cephalometric measurements and normative values 120

Vertical dentoalveolar relationships 121
- Inclination of the occlusal plane 121
- Anterior maxillary dental height 121
- Posterior maxillary dental height 121
- Anterior mandibular dental height 121
- Posterior mandibular dental height 122

Transverse skeletal relationships 122

References 122

SECTION 2 Facial Aesthetic Analysis: Facial Type, Proportions and Symmetry 123

Introduction to Section 2 123
- ‘Rules’ versus ‘guidelines’ in facial aesthetic evaluation 123
- Clinical inspection – the ‘process’ 123
- Clinical inspection – the ‘education of the eye’ 124

The diagnostic process – clinical evaluation 124
- Qualitative evaluation 124
- Quantitative evaluation and analysis 124

Clinical evaluation – the sequence 126

References 126

Chapter 8

**Facial Type** 127

- Introduction 127
- The fictional conception of the ‘normal’ 127
- Proportion indices 127
- Head type 129
- Cephalic index 129
  - Ethnic differences 130
  - Ethnic differences in white individuals 130
- Head circumference 130
  - Ethnic differences 130
- Facial type: frontal view (norma frontalis) 130
- Facial shape 130
  - Facial height-to-width ratio/proportion 131
- Facial index 131
- Facial type: profile view (norma lateralis) 132
- Facial divergence 132
- Sagittal facial profile contour 134
  - Angle of facial profile convexity (clinical/soft tissue) 134
  - Angle of facial profile convexity (cephalometric/skeletal) 135
  - Facial angle (clinical/soft tissue) 135
  - Facial angle (cephalometric/skeletal) 136
  - Cranial base angle 136
  - Anterior cranial base length 137
- Parasagittal facial profile contour 137
- Vertical facial profile form 137
  - Vertical facial growth pattern and hyperdivergent facial type 137
  - Horizontal facial growth pattern and hypodivergent facial type 138
  - Mandibular plane angle (clinical) 138
  - Mandibular plane angle (cephalometric) 139
  - Gonial angle (Ar-Go-Me) 139
  - Convergence of horizontal facial planes (Sassouni analysis) 140
  - Facial height to horizontal facial depth ratio (cephalometric) 140
  - Facial growth axes (cephalometric) 141

Facial curves and curvilinear relationships 141

Curvilinear relationships – frontal and profile views 142

Angularity of facial contour lines 142

Facial profile curves and ‘S-shaped’ curvilinear considerations 142

Contour defects 143

Sexual variation: the main differences between male and female faces 144

‘Ethnic’ variation: considerations in facial aesthetic evaluation 145

Historical background 145

Considerations in facial aesthetic evaluation 145

Facial ageing 146
### Chapter 9  
**Facial Proportions**

**Introduction**  
150

**Craniofacial height to standing height proportion**  
151

- Classical, Renaissance and neoclassical proportional canons  
151
- Anthropometric data  
155
- Attractiveness research  
155
- Clinical implications  
156

**Vertical facial proportions**  
156

- Vertical craniofacial bisection  
156
- Vertical facial trisection (Vitruvian trisection)  
156
- Vertical craniofacial tetrasection  
157
- Artist’s facial ‘grid’  
157
- Validity of proportional canons  
157
- Cephalometric evaluation – anterior face height ratio  
158
- Lower anterior facial proportions  
158
- Anthropometric vertical facial measurements  
159
- Comparison of proportional canons with modern measured proportional ratios  
159
- Attractiveness studies  
159
- Clinical implications  
160

**Transverse facial proportions**  
160

- The central fifth of the face  
160
- The medial fifths of the face  
163
- The lateral fifths of the face  
164

**References**  
164

**Oblique lateral (three-quarter) view**  
171

**Transverse occlusal plane view**  
171

**Dynamic clinical evaluation**  
172

- Mandibular lateral displacement  
172
- Asymmetrical facial animation  
174

**Dental midlines**  
174

- Maxillary dental midline  
174
- Mandibular dental midline  
175
- Distinguishing between mandibular and isolated chin asymmetry  
175

**Radiographic-cephalometric evaluation**  
176

- Posteroanterior cephalometric radiograph  
176
- Lateral cephalometric radiograph  
179
- Panoramic rotational tomography (OPT – orthopantomograph)  
179

**Three-dimensional imaging evaluation**  
180

- Dental study casts  
180
- Three-dimensional facial soft tissue scans  
180
- Computed tomography  
181
- Magnetic resonance imaging  
184

**Craniofacial growth and treatment timing**  
184

- Treatment timing  
184
- Superimposition of serial cephalometric images and other imaging modalities  
185
- Growth prediction  
185
- Nuclear medicine (scintigraphy)  
186

**References**  
188

### SECTION 3  
**Facial Aesthetic Analysis: Regional Analysis**

**Introduction to Section 3**  
189

**The modified subunit principle**  
189

**Relativity and the five facial prominences**  
190

- The five facial profile prominences  
191

**References**  
191

### Chapter 10  
**Facial Symmetry and Asymmetry**

**Introduction**  
165

**Relationship between symmetry and proportion**  
165

**Balance and harmony: a note on terminology**  
166

**Aetiology and classification of facial asymmetry**  
166

- Aetiology  
166
- Classification  
166

**Clinical evaluation**  
167

- Purpose of the clinical evaluation  
167
- Frontal facial examination  
167
- Superior view  
171
- Submental view  
171
- Lateral view  
171

**Upper Facial Analysis**  
192

### Chapter 11  
**The Forehead**

**Introduction and terminology**  
193

**Anatomy**  
193

**Clinical evaluation**  
194

- Frontal view  
194
- Profile view  
195
- Superior view  
197
- Curvilinear relationships  
197

**References**  
198
Chapter 12

The Orbital Region

Introduction
The eyes
Eyebrows
Terminology
Anatomy
Clinical evaluation
Eyebrow position and contour
Orientation of palpebral fissure
Eye width and interocular dimensions
Proportional relationships of the orbital region
Relationship of bony orbit and globe
Symmetry
References

Midfacial Analysis

Chapter 13

The Ears

Introduction
Terminology
Anatomy
Clinical evaluation
Ear position
Ear size and proportions
Ear axis
Ear protrusion (lateral projection)
Ear symmetry
References

Chapter 14

The Nose

Introduction
Terminology
Anatomy
Soft tissue features of the external nose
Skin of the external nose
Bony skeleton of the external nose
Cartilaginous skeleton of the external nose
Nasal type, topography and the subunit principle
Classification of nasal type
Topographic nasal landmarks and nomenclature
Nasal aesthetic subunits
Clinical evaluation
Profile evaluation
Basal evaluation
Relative nasal relationships – evaluation
Normative values for nasal dimensions
Nasal function
References

Chapter 15

The Malar Region

Introduction
Terminology
Anatomy
Clinical evaluation
Bizygomatic width
Malar position
Height of malar contour
Malar projection and sagittal contour
Area of maximal malar projection
Principles in planning the correction of malar deficiency
References

Chapter 16

The Maxilla and Midface

Introduction
Terminology
Terms of jaw position in the sagittal plane
Terms of maxillary position in the vertical plane
Terms of jaw size
Terms of maxillary bodily movement in the three planes of space
Terms of maxillary rotation around the three axes of rotation
Anatomy
Maxillary deficiency
Sagittal maxillary deficiency
Vertical maxillary deficiency
Transverse maxillary deficiency
Principles in planning the correction of maxillary deficiency
Maxillary excess
Sagittal maxillary excess
Vertical maxillary excess
References
Contents

Transverse maxillary excess 265
Principles in planning the correction of maxillary excess 265
Maxillary asymmetry 266
References 267

Lower Facial Analysis 268

Introduction 268

Chapter 17

The Lips 269

Introduction 269
Anatomy 269
Embryology 269
Anatomy 269
Ageing 270
Terminology 271
Clinical evaluation 271
Lip lines 271
Lip activity (function) 272
Lip morphology (form) 273
Lip posture 280
Lip prominence 281
References 286

Chapter 18

Mentolabial (Labiomental) Fold 288

Introduction 288
Mentolabial fold (sulcus) depth 288
Mentolabial angle 288
Vertical position of the mentolabial fold 291
Mentolabial fold morphology 291
Advantages of mandibular advancement surgery over isolated genioplasty 291
Influence of mentolabial fold morphology on management of chin deformities 292
Influence of vector of bony chin movement on mentolabial fold morphology 292
Influence of lower anterior face height on mentolabial fold morphology 292
References 294

Chapter 19

The Mandible 295

Terminology 295
Anatomy, morphology and size 295

Chapter 20

The Chin 312

Introduction 312
Anatomy 312
Terminology 313
Chin excess and chin deficiency 313
Classification of chin deformities 318
Clinical evaluation 321
Sagittal evaluation and chin projection 321
Sagittal position of soft tissue chin 322
Sagittal position of hard tissue (skeletal) pogonion 326
Indirect morphological influences on sagittal chin projection 328
Soft tissue chin pad 328
Mentolabial fold and chin pad morphology 329
Dynamic chin pad evaluation 329
Mentalis muscle – anatomy, activity and significance 330
Vertical chin height 332
Proportional relationships 332
Mandibular anterior dental height 332
Transverse chin width 333
References 333

Chapter 21

Submental-Cervical Region 335

Introduction 335
Anatomy 335
Terminology 335
Aetiology 336
Aetiology of poor submental-cervical contour 336
Clinical evaluation 337
Skeletal pattern (jaw relationship) 337
Morphology of the submental soft tissues 338
Submental-facial angle 341
Submental length 341
Submental-neck (submental-cervical) angle 341
Submental-sternomastoid (SM-SM) angle 344
Submental soft tissue thickness 344
Hyoid bone position and submental-cervical aesthetics 344
Relative submental projection and aesthetics 347
References 348

SECTION 4 Smile and Dentogingival Aesthetic Analysis 351

Introduction to Section 4 351

Dental-Occlusal Relationships: Terminology, Description and Classification 353

Introduction 353
Terminology 353
Terms of description of tooth form 353
Terms of direction in dental nomenclature 353
Terms of tooth position in the three planes of space 354
Terms of bodily tooth movement in the three planes of space 354
Terms of tooth rotation around the three axes of rotation 354
Dental occlusion 355
The concept of ‘ideal’ occlusion 355
Curves of the occlusion 356
Aims of treatment and the ‘six keys’ to ‘ideal’ occlusion 356
Classification of dental-occlusal relationships 358
Incisor relationships 358
Buccal segment relationships (canine and molar relationships) 360
The term ‘Class’ and classification 362
The aetiology of malocclusion 364
Skeletal factors 364
Soft tissue factors 365
Local factors 367
Habits 367
Oral health 367
Dental condition 367
Oral hygiene and gingival/periodontal condition 368
Oral mucosa 368
Occlusal function 368
Dynamic occlusal function 368
Temporomandibular joint function 368
References 368

Chapter 23
Smile Aesthetics with Daljit S. Gill 370
Introduction 370
Importance of the smile in facial aesthetics 370
Types of smile 370
The generation of a smile 371
Clinical evaluation 371
Lip aesthetics 371
Lip lines 371
Upper lip–maxillary incisor relationship 372
Incisor exposure and phonetic analysis 375
Incisor exposure and anterior occlusal guidance 377
Smile symmetry 377
Dynamic upper lip curvature 377
Orientation of the transverse occlusal plane 377
Orientation of the sagittal occlusal plane 378
Smile curvature (smile arc) 378
Dental midlines 380
Buccal corridors (negative space) 382
Smile aesthetics in profile view 383
References 386

Chapter 24
Dentogingival Aesthetics with Daljit S. Gill 387
Introduction 387
Anatomy 387
The concept of ‘biological width’ 388
Clinical evaluation 389
Tooth shape 389
Theories of ‘ideal’ tooth shape 389
Tooth size 391
Width-to-height ratio of maxillary central incisor crown 391
Seventh key and dental occlusion 392
Tooth size analysis 392
Tooth proportions 392
Tooth symmetry 394
The unilaterally peg-shaped or congenitally absent maxillary lateral incisor 394
Arch form 395
<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maxillary incisor axial angulations</td>
<td>395</td>
<td>Arch shade progression</td>
<td>402</td>
</tr>
<tr>
<td>Gradation (front-to-back progression)</td>
<td>396</td>
<td>Tooth shade value contrast with skin colour</td>
<td>402</td>
</tr>
<tr>
<td>Gingival aesthetics</td>
<td>398</td>
<td>Age changes</td>
<td>402</td>
</tr>
<tr>
<td>Gingival colour, texture and biotype</td>
<td>398</td>
<td>Clinical shade selection</td>
<td>402</td>
</tr>
<tr>
<td>Gingival level</td>
<td>398</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gingival contour</td>
<td>399</td>
<td>References</td>
<td>403</td>
</tr>
<tr>
<td>Contacts, connectors and embrasures</td>
<td>400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tooth colour</td>
<td>402</td>
<td>Index</td>
<td>405</td>
</tr>
<tr>
<td>Description of tooth colour</td>
<td>402</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>