Index

Note: Page numbers in italics refer to figures, those in bold refer to tables.

abrasions 245
child physical abuse and neglect 245
soft tissue injuries 626, 628, 629, 630–631
abuse see also child physical abuse and neglect
physical abuse, etiology of traumatic dental injuries 271–272
accident site, healing optimization 203–204
acetylcholine, wound healing 14
actuarial statistics, prognosis 956–958
adolescence (13–20 years) psychological development stage 230
psychosocial aspects of traumatic dental injuries 234
treatment plan 234
adult patients
ankylosis 835–836
discussion post treatment 236
economic aspects of traumatic dental injuries 237
follow-up treatments 236–237
psychosocial aspects of traumatic dental injuries 236
wound healing 44–45
age influence, wound healing 44–45
alcohol influence, wound healing 43
alendronate (ALN), healing optimization 208
alveolar bone and marrow complex 106
growth and maintenance 86
histologic evidence of socket healing 89
response to infection 89–92, 90, 91
response to trauma 86–89
teeth with developed roots 86–92, 86, 87, 88
alveolar bone development, decoronation of ankylosed teeth 838–846
alveolar fractures
alveolar socket wall fractures 529–551
antibiotics 128
cone beam computed tomography (CBCT) 317
intra-alveolar root fractures 759–761, 765, 766, 767
radiographic examination 315, 317
radiographic findings 530–536
splinting 969
alveolar process, implant therapy 894
alveolar process fractures 529–551, 530
primary teeth injuries 569–570, 582
prognosis 544–545, 551
treatment 540
treatment delay 129
alveolar socket comminution 530, 538
alveolar socket wall fractures 529–551, 530
clinical findings 529, 530, 531
prognosis 544
treatment 536–540
ameloblasts 16, 74, 105
see also inner enamel epithelium
angiogenesis
cellular events 32–35
factors controlling 35
growth factors 17
wound healing 17, 31–35, 32, 33, 34
angiogenesis/neovascularization, wound healing 7
ankylosis 834–850
adult patients 835–836
alveolar bone development 838–846
clinical diagnosis 835, 850
decoronation 838–850
development 835
implants and root remnants 849–850
infra-position (infraocclusion) 836–838, 839, 848
luxation injuries 567
periodontal ligament (PDL) 834–835
prevention 835
primary teeth injuries 567, 582
progression 835
treatment options 836–838, 839, 850
young patients 836
ankylosis-related resorption (replacement resorption) 430, 432, 433, 434
healing complications 134, 136
periodontal healing 513–515, 514, 515
periodontal ligament (PDL) 83–85, 84
antibiotics see also doxycycline; minocycline; tetracycline
alveolar fractures 128
avulsion and replantation 128
bacterial invasion types 127–128
crown fractures 128
crown infractions 128
crown fractures 128
luxation injuries 128
periodontal healing 128
prophylaxis, soft tissue injuries 642–643, 643
replantation and avulsion 128
role 127–128, 129
root fractures 128
systemic administered antibiotics and periodontal healing 128
topically administered antibiotics and periodontal healing 128
anti-inflammatory drugs using the root canal as a reservoir 211–215
apexification 680–688, 681–685
artificial barriers, infection 683–684, 687, 689
assessment, treatment see treatment assessment
audiovisual methods, information on
assessment, treatment see treatment assessment
avulsion injuries 927
ceramic laminate veneers 867–870
combined orthodontic closure and autotransplantation 870, 872
canines 858–859
canines 927
canines 858–859
completed root formation 870–872
composite restoration 865–867, 868–869
dental papilla 865
donor tooth selection 862–863
follow-up period 859–861
graft removal and insertion 856–859, 874
graft selection 854, 855, 856, 857, 874
implants vs autotransplants 853–854
indications 874
maxillary central incisors
replacement 927
open procedure 855–856, 860
orthodontic considerations 862–864
orthodontic treatment of transplanted teeth 864, 874
overjet 863
periodontal healing 862
predictors of healing 873–874
premolar transplantation vs orthodontic space closure 863–864
preparation of the recipient site 855, 858–859
prognosis 872–874
prosthetic restoration 874
pulpal healing 861–862
restorative considerations 864–867
root development 861, 862
safety restoration 865
space conditions 855, 863
splinting 969
surgical considerations 853–854
surgical procedure 854–862, 874
tooth morphology and color
match 864–865
treatment planning 853
young patients 884–886
autotransplantation 767–771
clinical findings 486, 487, 488, 519
complications after premature loss of permanent teeth 517–518, 520
etiology 486, 519
first aid treatment 1004
follow-up 503, 505, 507
forces 776–777
frequency 486, 519
gender 774
gingival healing and loss of marginal attachment 517
healing 486–499, 519
healing complications 133
healing optimization 204, 205, 206
healing with ankylosis-related resorption (replacement resorption) 493–496, 495, 496
healing with a normal periodontal ligament 492, 494
healing with repair-related resorption (surface resorption) 492–493
heredity 774
history 519
infection-related resorption 495, 496–499, 498, 499, 500, 509, 515, 516
infection-related root resorption 495, 498, 515, 516
local factors 775–776
long-term results of replantation 508
malformation in the developing dentition 517–518
mechanisms 487
orthodontic treatment 764–779
pathology 486–499, 519
periodontal healing 508, 510–515
periodontal healing reactions 491–496
phantom roots 517, 518
primary teeth injuries 576, 576, 583
prognosis 503–507, 520
pulpal healing 507–510, 510, 511, 512, 518
pulpal reactions 486–489, 489
pulp canal obliteration (PCO) 509
pulp necrosis 507–510
pulp responses to trauma 675–676
radiographic findings 486, 488, 519
replantation 126–129, 486–518, 498, 519, 771, 775
resorption by erupting teeth 515
root development and disturbances in root growth 515–517
root resorption 501, 503, 507, 510–515, 519–520
socioeconomic burden of tooth replantation 518
soft tissue injuries 627, 629, 633, 640–642
space closure 764–767, 772, 786
splinting 501, 502, 505, 506, 509
systemic factors 774–775
terminology 486, 519
tooth survival and tooth loss 507
trauma 776
treatment 499–503
treatment at site of accident 499–501, 519
treatment at the clinic 501–503, 502, 504–507
bacterial invasion types 127–128
battered child syndrome see also child physical abuse and neglect
primary teeth injuries 559
behavioral causes, etiology of traumatic dental injuries 267–268
biofactors and cell sheets, bio-roots 163, 164
bio-roots 161–167
allogenic DPSC/PDLSC-mediated root/ periodontal structure as an artificial crown support for the restoration of tooth function in swine 165
bioengineered dentin-induced PDL/ cementum-like tissue formation 166
biofactors and cell sheets 163, 164
biomechanical properties and element analysis 166
challenges 166–167
clinical assessment and evaluation of bio-roots and dental implants 165–166
comparison of allogeneic DPSC/ PDLSC-mediated bio-root and implant-based restoration for the restoration of tooth function in swine 165
definition 161
dental pulp stem cells (DPSCs) 162
development history 161–162
functional tooth regeneration 164–165
gelfoam scaffolds containing PDLSCs 164
hydroxyapatite/tricalcium phosphate (HA/TCP) scaffolds 163
insertion and cementation of a pre-made porcelain crown and functional evaluation 164–165
isolation and culture of SCAP 164
mesenchymal stem cells (MSCs) 162
non-dental stem cells 163
periapical follicle stem cells (PFAFs) 162–163
periodontal ligament stem cells (PDLSCs) 162
preparation of the lower incisor socket and implantation of a HA/SCAP-gelfoam/PDLSC structure 164
prospects 166–167
regeneration procedure of stem cell-mediated bio-roots 165, 166
root-shaped HA/TCP carrier loaded with SCAP 164
scaffolds 163
SCAP/PDLSC-mediated root/ periodontal structure as an artificial crown support for the restoration of tooth function in swine 164–165
stem cell-based tissue engineering and functional bio-root regeneration 165, 166
stem cell-mediated bio-root regeneration 162–165
stem cells from apical papilla (SCAP) 162
treated dentin matrix (TDM) scaffold 163
bite marks, child physical abuse and neglect 245–246
bleaching 972–979
see also discolorations of enamel
adverse effects 975–976, 977
clinical recommendations 978, 979
efficacy 974–975, 978
esthetics 975, 976, 977
etiology of discoloration 972
external tooth bleaching 976–978
historical overview 972
indications 978
intracoronal bleaching 973–976
medications 972–973
methods 973–974, 975
mode of action 972–973
precautions 978
prognosis 979
restorations effects 980
precautions 978
mode of action 972–973
methods 973–974,
cellular components and mediators, cells involved in wound healing 1, 2, 46
clinical examination form for the time of injury and follow-up examinations 1023
complications, healing see healing complications compounds and tissues, wound healing 9–13
drug interactions 443–448, 449
preoperative evaluation 443–445
symptoms 443–445
weakness of the pulp and dentin 449
postoperative complications 445–448
associated crown fracture 445–448
breakdown 445
primary teeth injuries 445–448, 449
complications 444–445
definitions 444, 445
follow-up 444
frequency 443
pathology 443
predictors for healing and prognosis 445–448
associated crown fracture 445–448
primary teeth injuries 570
pulp canal obliteration (PCO) 449
pulp necrosis 444, 445–448, 447, 449
pulp responses to trauma 672–674
radiographic findings 443
root resorption 445, 449
treatment 443–444, 446
cone beam computed tomography (CBCT)
alveolar fractures 317
periapical healing 316, 318
pulpal healing 316, 318
radiographic examination of traumatic dental injuries 312–313, 315, 315, 317
root fractures 315, 379–382
root resorption 316–317, 319
confidence limits, prognosis 959–960
healing optimization 202–224
accident site 203–204
alendronate (ALN) 208
anti-inflammatory drugs using the root canal as a reservoir 211–215
avulsion injuries 204, 205, 206
calcitonin 208, 210, 211
corticosteroids 205–215
corticosteroids 206–208
Dexamethasone 206, 208, 208
doxycycline 207, 216
Emdogain (enamel matrix protein) 208–210, 211, 212
equipment treatment of the root 218–224, 220, 221
general strategies 205–215
healing types 202–203
inflammation limiting 215–216, 218
Ledermix 213–215, 214, 215, 216, 217
minocycline 206, 207
oral wound healing 45–46
osteoclasts 202, 203
penicillin 215–216, 218, 219, 222, 223
periodontal ligament (PDL) 202–221, 224
physical methods 205
pulpal healing 224
saline cleansing 203–204
slow release anti-inflammatory drugs using the root canal as a reservoir 211–215
systemic methods to limit inflammation 215–216, 218
tissue storage medium 210–211
treatment strategies 203–204
ViaSpan 210–211
healing process, wound healing 1–2
healing types
favorable healing 202–203
unfavorable healing 202–203
heated gutta-percha, thermal pulp testing 303
hemostasis phase, wound healing 9–11
heparin and heparan sulfate proteoglycans, wound healing 13
Hertwig's epithelial root sheath (HERS) 105–106
developing teeth 72, 75, 76, 77
response to infection 73–76
response to trauma 73
histamine, wound healing 13–14
history
avulsion injuries 519
bio-roots, development history 161–162
crown fractures 346
examination and diagnosis of traumatic dental injuries 296–298, 320
regenerative endodontic procedures (REPs) 721–722
root fractures 407
supporting bone injuries 548
homeostatic mechanism, periodontal ligament (PDL) 81–82
hormones, RANKL-induced differentiation of mononuclear osteoclast progenitors 177–178
human hand marks, child physical abuse and neglect 244–245, 245
Hunt flow diagram, wound healing 3, 3
hyaluronic acid and proteoglycans, wound healing 13
hydroxyapatite/tricalcium phosphate (HA/TCP) scaffolds, bio-roots 163
hyperbaric oxygenation, wound healing 42–43
hypertrophic scar and keloid, wound healing 37–38
IAEDT see International Association of Dental Traumatology
iatrogenic injury developing teeth 591–592, 592, 593
primary incisors 559
iatrogenic procedures, etiology of traumatic dental injuries 272–273
ice, thermal pulp testing 303, 304
IGF (insulin-like growth factor), wound inflammation limiting, healing 215–216
illness, etiology of traumatic dental injuries 271
impetiginous lesions child physical abuse and neglect 247, 248
differential diagnosis 247, 248
implant-supported single crowns (ISC) 829–832
implants vs autotransplants 835–854
implant therapy 888–905
alveolar process 894
biologic aspects in esthetic implant sites 890–891
bone augmentation 894
bone harvesting 902–905
bone splitting 895
canines 927–928
comfort zones 892
coronal-apical positions 891, 892
danger zones 892
esthetics 890–891
guided bone regeneration (GBR) 895
horizontal augmentation techniques 894–895
ideal implant position 891–892
indications 888
maxillary central incisors replacement 927
mesio-distal dimension 891, 892
onlay grafts 894–895
oro-facial dimension 891, 892
papillae 893
peri-implant mucosa 893–894
prognosis 905
proximal alveolar bone 894
segment osteotomy with interpositional graft 902
single-tooth implants, esthetics 918–923
soft tissue appearance 893–894
timing of implant placement 889–890
titanium mesh 895
treatment planning 888–890
vertical augmentation techniques 901–902
implant treatment planning, young patients 882–886
inappropriate use of teeth, etiology of traumatic dental injuries 270–271
incidence, traumatic dental injuries 262–263, 263, 282
infants
psychosocial aspects of traumatic dental injuries 233
treatment plan 233
infection
artificial barriers 683–684, 687, 689
dental follicle 68, 71
diagnosis 676–678
management 679–689
primary teeth injuries 557, 559
root fractures 383, 384, 667
wound healing 43, 45
infection-related resorption 134, 135, 429, 433, 496–499
avulsion injuries 495, 496–499, 498, 499, 500, 509, 515, 516
healing complications 134, 135
management 690–691, 693–694, 694–695
inflammation limiting, healing optimization 215–216, 218
inflammation phase, wound healing 5, 6
inflammatory phase mediators, wound healing 13–14
inflammatory resorption see infection-related resorption
information on traumatic dental injuries 992–1004
audiovisual methods 996
brochures 996
e-health 996–999
emergency services 1001, 1002, 1003
first aid treatment 1004
how to act at the place of accident 993–999
insurance 1003–1004
information on traumatic dental injuries (cont’d)
Internet 996–999
lay people 993
lectures 994–995, 996
medical professionals 994, 998–999
m-Health 998–999
parents 993
patients 997, 1001–1004
posters 995
preventing dental and oral injuries 992–993
social media 997–998
teachers 994
infraposition (infraocclusion)
ankylosis 836–838, 839, 848
rate 846–847, 849
treatment options 836–838, 839
inhalation of foreign bodies, examination 631–633,
see also trauma
injury types
child physical abuse and neglect 243–247
traumatic dental injuries 1003–1004
internal root resorption 103
primary teeth injuries 581, 582
International Association of Dental Traumatology (IADT) 1015–1018
Dental Trauma Guide (DTG) 1009, 1018
IADT World Congresses 1016, 1017
mission statement 1016
patient information 997
posters 995
treatment guidelines, intrusive luxation 482–484
treatment guidelines for traumatic dental injuries 1016–1018
Internet, information on traumatic dental injuries 996–999
intra-alveolar root fractures, orthodontic treatment 759–761, 765, 766, 767
intracellular signaling, osteoclasts 172–173
intrusive luxation 417, 469–484
see also intrusive luxation; lateral luxation; luxation injuries
clinical findings 469, 470, 471, 571–573
definition 469, 470
diagnosis of healing complications 477–482
frequency 469
healing 469
healing complications 133
healing complications diagnosis 477–482
marginal bone loss 477, 481–482
orthodontic extrusion 474–477, 475–476
orthodontic treatment 761, 786
pathology 469, 470
predictors of healing 482, 483, 484
primary teeth injuries 571–576, 574–575, 583
prognosis 477, 480, 573–576
pulp necrosis 477, 480
pulp responses to trauma 675
radiographic findings 469–471, 472–473, 573
root resorption 477, 481
splinting 969
spontaneous re-eruption 474, 474
surgical extrusion 477, 478–479
surgical repositioning 477, 478–479
tooth survival 477–482, 482, 483
treatment 473–477, 473, 573
treatment alternatives 484
treatment guidelines 482–484
treatment guidelines according to trauma scenario 477
invasive cervical resorption 701–705
management 703–705
pathogenesis 701–703
invasive coronal resorption 700–701
management 700–701
pathogenesis 700
invasive radicular resorption 705–707
invasive tooth resorption following trauma 699–707, 708–709
invasive cervical resorption 701–705
invasive coronal resorption 700–701
invasive radicular resorption 705–707
investigation perios, prognosis 959
ISC (implant-supported single crowns) 829–832
prognosis 831
jaw bone
jaw tumors and cysts 188–189
osteoclasts role 187–191
osteonecrosis of the jaws 190–191
periodontitis 187–188
remodeling of jaw bones 187
tooth eruption 189
tooth movement 189–190
jaw fractures 188
see also mandible or maxilla fractures
developing teeth injuries 589–591, 591
jaw tumors and cysts
osteoclasts 188–189
receptor activator of nuclear factor κB ligand (RANKL) 188–189
joint diseases, osteoclasts role 186
lacerations
child physical abuse and neglect 245, 246
foreign bodies 631–633, 634–637, 640, 641
gingival lacerations 631, 632–634, 644
lip lacerations 631–640, 634–640, 644
soft tissue injuries 626, 629, 631–640
tongue lacerations 640, 641, 644
vestibular lacerations 631, 634
laminites restorations 807–821
bonding 814–815, 816
dentine sealing 814
essentials 820–821
failure modes 818, 819–820, 821
impressions 814, 815
incisal edge reduction 711, 812
longevity and risk factors 817–818, 819
material considerations 809–810
overall bulk reduction 814
palatal finishing line 814
patient assessment 807–809
review and maintenance 815–820
tooth preparation 810–814
veneer design 810–814
laser Doppler flowmetry (LDF), pulp testing 302–303, 308–309, 423
lateral luxation 417, 450–466, 467
see also extrusive luxation; intrusive luxation; luxation injuries
clinical findings 450, 452, 453
definition 450, 452
endodontics 461–464
equipment 302–303, 308–309, 423
frequency 450
healing 450
healing complications 464
marginal bone loss 464, 464, 465
pathology 450
periodontal ligament (PDL) 463
predictors of healing 464–465, 467
primary teeth injuries 571, 571, 572, 583
prognosis 454
pulpal healing 462
pulp canal obliteration (PCO) 457
pulp necrosis 457, 462, 464, 465
pulp responses to trauma 674–675
radiographic findings 451, 453
root resorption 457–461
splinting 968–969
tooth survival 465
treatment 457
lateral root angulation or dilaceration, developing teeth injuries 605–607, 607, 613–616, 614–616
LDF (laser Doppler flowmetry), pulp testing 302–303, 308–309, 423
learning difficulties, etiology of traumatic dental injuries 271
lectures, information on traumatic dental injuries 994–995, 996
Ledermix, healing optimization 213–215, 214, 215, 216, 217
Leigh disease, self-inflicted oro-dental injuries 558–559
Lesch-Nyhan syndrome, self-inflicted oro-dental injuries 558–559
magnetic resonance scanning, radiographic examination of traumatic dental injuries 318
malignancies, osteoclasts role 186–187
mandible or maxilla fractures 529–551, 530
see also jaw fractures
adults 546–548
antibiotics 128, 543
children 545–546
fibrous union 546–547
gingival healing and loss of marginal attachment 548
inflammation at the line of fracture 547
periodontal healing 548
prognosis 551
pulpal healing 547–548
pulp necrosis 547–548
root resorption 548
splinting 543–544
teeth in the line of fracture 540–544
treatment delay 129, 543
marginal bone loss
extrusive luxation 463, 464
healing complications 133
intrusive luxation 477, 481–482
lateral luxation 464, 464, 465
predictors 137
mast cells, wound healing 20, 22
matrix, wound healing 13
maxilla fractures see mandible or maxilla fractures
maxillary anterior teeth, multiple loss, esthetics 928
maxillary central incisors replacement, esthetics 912–926
maxillary lateral incisors replacement, esthetics 926–927
M-CSF (macrophage colony-stimulating factor), osteoclasts 170–174, 171–172
MDTE (multiple dental trauma episodes), economic aspects of traumatic dental injuries 986
mechanical stimulation, examination and diagnosis of traumatic dental injuries 303
muscle function, wound healing
necrosis, pulp see pulp necrosis
nerve root canal, wound healing 13
neovascularization/angiogenesis, wound healing 7
neurotransmitters, wound healing 14
neutrophils, wound healing 20–24, 22, 23
non-dental stem cells, bio-roots 163
norepinephrine, wound healing 14
observation periods, orthodontic treatment 777–779, 785
ODHRQoL (Oral Health-Related Quality of Life) measures, psychosocial impacts of traumatic dental injuries 227, 229, 231
OISD (orthodontic implant site development), esthetics 923–926
onlay grafts, implant therapy 894–895
OPG (osteoprotegerin), osteoclasts 173–174
optimization, healing see healing optimization
microenvironment, wound healing 39–41
mineral trioxide aggregate (MTA) 654–655
pulpotomy 659–663
root fractures 669
minocycline
healing optimization 206, 207
periodontal ligament (PDL) 206, 207
mobility testing, examination and diagnosis of traumatic dental injuries 301
mouthgaurds see also facegaurds
anesthesia 949–950
applications 948–951
care of mouthgaurds 947–948
custom mouthgaurds 943–947
diagnosis of traumatic dental injuries 938–951
endoscopy 952
fabrication 943–947
functions 939–940
orotracheal intubation 952
preventing dental and oral injuries 938–951
special considerations 947
sports activities 948–949, 951
traffic accidents 950–951
types 940–943
MSCs see mesenchymal stem cells
MTA see mineral trioxide aggregate
multiple dental trauma episodes (MDTE), economic aspects of traumatic dental injuries 986
multiple regression analysis, prognosis 999
necrosis, pulp see pulp necrosis
nerve root canal, wound healing 13
neovascularization/angiogenesis, wound healing 7
neurotransmitters, wound healing 14
neutrophils, wound healing 20–24, 22, 23
non-dental stem cells, bio-roots 163
norepinephrine, wound healing 14
Oral Health-Related Quality of Life (OHRQoL) measures, psychosocial impacts of traumatic dental injuries 227, 229, 231
oral mucosa and skin 103–105, 106
classification of traumatic dental injuries 253, 257, 281
response to infection 104–105
response to injury 103–104
organization of emergency care, traumatic dental injuries 279–281, 282
orthodontic extrusion, intrusive luxation 474–477, 475–476
orthodontic implant site development 81
osteoblasts, periodontal ligament 81
orthodontic space closure see also space closure
esthetics 923–926
orthodontic space closure
response to injury 103–104
response to infection 104–105
organization of emergency care, traumatic dental injuries 279–281, 282
orthodontic extrusion, intrusive luxation 474–477, 475–476
orthodontic implant site development 81
osteoblasts, periodontal ligament 81
response to injury 103–104
response to infection 104–105
organization of emergency care, traumatic dental injuries 279–281, 282
orthodontic extrusion, intrusive luxation 474–477, 475–476
orthodontic implant site development 81
osteoblasts, periodontal ligament 81
response to injury 103–104
response to infection 104–105
organization of emergency care, traumatic dental injuries 279–281, 282
orthodontic extrusion, intrusive luxation 474–477, 475–476
orthodontic implant site development 81
osteoblasts, periodontal ligament 81
response to injury 103–104
response to infection 104–105
organization of emergency care, traumatic dental injuries 279–281, 282
orthodontic extrusion, intrusive luxation 474–477, 475–476
orthodontic implant site development 81
osteoblasts, periodontal ligament 81
intracellular signaling 172–173
jaw bone role 187–191
jaw tumors and cysts 188–189
joint diseases 186
macrophage colony-stimulating factor (M-CSF) 170–174, 171–172
malignancies 186–187
minerals dissolution 176
modeling 184, 184
mononuclear osteoclast progenitors, RANKL-induced differentiation 177–181
morphology 174–176
osteoclastic resorption 174–176, 175
osteoclastogenesis 169–174
osteoclast progenitor origin 181–182
osteonecrosis of the jaws 190–191
osteopetrosis 185–186
osteoporosis 185
osteoprotegerin (OPG) 173–174
periodontal ligament (PDL) 81, 82
periostitis 187–188
physiologic role 182–185
receptor activator of nuclear factor κB ligand (RANKL) 170–174, 171–172, 177–181
regulation of mature osteoclast activity 181
remodeling 182–183, 187
remodeling of jaw bones 187
retinoids 178
rheumatoid arthritis 186
sealing zone and ruffled border 174–176
semaphorin 181
skeletal diseases role 185–187
sphingosine-1-phosphate (S1P) 182
stomal cell-derived factor 1 (SDF-1) 182
tartrate resistant acid phosphatase (TRAP) 177
tooth eruption 189
tooth movement 189–190
tooth resorption 191
Wnts 179–181, 191
osteonecrosis of the jaws, osteoclasts 190–191
osteopetrosis, osteoclasts role 185–186
osteoporosis, osteoclasts role 185
osteoprotegerin (OPG), osteoclasts 173–174
overjet 758
autotransplantation 863
predisposing factor 265–266
preventing dental and oral injuries 752, 933–934
oxygenation, wound healing 41–43
PAFSCs (periapical follicle stem cells), bio-roots 162–163
pain assessment 235–236
child patients 234–236
procedural pain treatments 234–236
verbal reports 235–236
panoramic technique, radiographic examination of traumatic dental injuries 312
parents, instructions to information on traumatic dental injuries 993
primary teeth injuries 583
pathogenesis crown fractures 279
crown-root fractures 278
luxation injuries 277
primary teeth injuries 560, 560, 583
root fractures 277, 378, 385
pathology avulsion injuries 486–499, 519
concussion/subluxation 443
crown fractures 329–332, 347
crown-root fractures 358, 359–360
developing teeth injuries 593–611
extrusive luxation 450
intrusive luxation 469, 470
lateral luxation 450
luxation injuries 415–417, 438
primary teeth injuries 560
root fractures 382–391, 407
supporting bone injuries 536, 550
patient information on traumatic dental injuries 1001–1004
International Association of Dental Traumatology (IADT) 997
PCO see pulp canal obliteration
PDGF (platelet-derived growth factor), wound healing 15, 16
PDL see periodontal ligament
PDLSCs see periodontal ligament stem cells
penicillin, healing optimization 215–216
periostitis 187–188
pericoronitis, wound healing 31
periodontal fibroblasts 79–81
periodontal healing
ankylosis-related resorption (replacement resorption) 513–515, 514, 515
antibiotics 128
autotransplantation 862
avulsion injuries 491–496, 508, 510–515
contamination of the root surface 513, 514
growth factors 18
mandible or maxilla fractures 548
splinting 125–126, 512, 962
stage of root development 512
storage media 512
systemic administered antibiotics 128
time of pulp extirpation 513
topically administered antibiotics 128
periodontal ligament (PDL) 106
ankylosis 834–835
ankylosis resorption 83–84, 85
bleeding and edema 83
cementoblasts 79
concussion/subluxation 416
contusion injuries 83–84, 85
epithelial rests of Malassez 81
extrusive luxation 416, 418, 463
healing complications 132–133
healing optimization 202–221, 224
homeostatic mechanism 81–82
intrusive luxation 417
lateral luxation 417, 463
luxation injuries 416–417
normal/damaged 834–835
osteoblasts 81
osteoclasts 81, 82
periodontal fibroblasts 81, 82
periodontal ligament fibers 81
periodontal vasculature 81
periodontal innervation 81
periodontal fibroblasts 79–81
osteoblasts 81, 82
physical leisure activities, etiology of traumatic dental injuries 268–270
physical limitations, etiology of traumatic dental injuries 271
physical methods, healing optimization 205
place of injury, traumatic dental injuries 266
plan, treatment see treatment plan
platelet concentrate/platelet-rich plasma, growth factors 18–19
platelet-derived growth factor (PDGF), wound healing 15, 16
platelet-rich plasma (PRP), wound healing 15
platelets, wound healing 19–20, 21
PO (pulse oximetry) 302, 309
physical methods 221
primary dentition, splinting 969
primary healing, wound healing 8
primary teeth injuries 556–583
alveolar process fractures 569–570, 583
ankylosis 567, 582
avulsion injuries 576, 576, 583
battered child syndrome 559
chin trauma fractures 570, 583
clinical findings 562–576
complications 576–581, 583
concussion/subluxation 570
crown fractures 565–566, 567–568, 583
crown fractures with pulp exposure 560, 561, 583
crown-root fractures 568–569
epidemiology 557–561, 562, 563, 582
etiology 557–561, 562, 563
examination 562–565, 583
extraoral examination 562–563
extrusive luxation 570–571, 583
first aid treatment 1004
healing 560
iatrogenic injury to the primary incisors 559
infection 557, 559
information to parents 1001
instructions to parents 583
internal root resorption 581, 582
intraoral examination 564
intrusive luxation 571–576,
574–575, 583
lateral luxation 571, 571, 572, 583
luxation injuries 560–561, 562, 563,
571–573, 583
objectives of trauma management 557
orthodontic treatment 752–753, 754
parents, instructions to 583
pathogenesis 560, 560, 583
pathology 560
permanent teeth damage 557, 559
pulp canal obliteration (PCO) 580
pulp healing complications 576–578, 578
pulp necrosis 567, 578–580, 579
pulp vitality 564
radiographic findings 564–567
repair-related resorption (surface resorption) 580–581
root canal treatment 579–580
root fractures 583
root resorption 580–581, 582
self-inflicted oro-dental injuries 558–559
space loss after premature tooth loss 581, 582
speech problems due to early loss of primary incisors 581–582
speech problems 583
treatment delay 129
treatment factors 536, 557, 558
treatment regimens 565
irreversible pulp necrosis, diagnosis of 424
lateral luxation 457, 462, 464, 465
luxation injuries 418–428, 425
mandible or maxilla fractures 547–548
observation without endodontic intervention 424
predictors 137, 580
prevalence 418, 419
primary teeth injuries 567, 578–580, 579
prognosis 956
pulp bone (internal bone formation) 424
vs pulp canal obliteration (PCO) 425
pulp testing 419–423
radiographic changes 423–424
root development stage 419, 420
root fractures 398–400, 399, 400, 467
supporting bone injuries 551
transient apical breakdown 423–424
type of luxation injury 419, 420
pulpotomy 656–663
calcium hydroxide 656–659
mineral trioxide aggregate (MTA) 659–663
prognosis 663
pulp responses to trauma 670–676
avulsion injuries 675–676
conclusion/subluxation 672–674
extrusive luxation 674
intrusive luxation 675
lateral luxation 674–675
pulp testing 301–303
electrometric pulp testing (EPT) 302–303, 305–307, 422–423, 422
examination and diagnosis of traumatic dental injuries 301–307, 320
laser Doppler flowmetry (LDF) 302–303, 308–309, 423
pulp necrosis 419–423
pulse oximetry (PO) 302, 309, 310
thermal pulp testing 303–304, 320
pulse oximetry (PO) 302, 309, 310
radiographic changes, pulp necrosis 423–424
radiographic examination of traumatic dental injuries 309–318
alveolar fractures 315, 317
cone beam computed tomography (CBCT) 312–313, 315, 315, 317
crown-root fractures 315
examination and diagnosis of traumatic dental injuries 320
extraoral techniques 312–318
intraoral techniques 309–312
magnetic resonance scanning 318
micro CT scanning 313–315
panoramic technique 312
periapical healing 316
periodontium injuries 315
photographic documentation 318
pulpal healing 316
root fractures 315, 316
root resorption 316–317, 319
radiographic findings
avulsion injuries 486, 488
conclusion/subluxation 443
crown fractures 329, 346
crown-root fractures 355–356, 357–358
developing teeth injuries 593–611
extrusive luxation 451, 453
intrusive luxation 469–471, 472–473, 573
lateral luxation 451, 453
luxation injuries 414–415, 415, 438
primary teeth injuries 562–576
root fractures 377–382, 379, 380, 381, 407
supporting bone injuries 530–536
radiographic responses, regenerative endodontic procedures (REPs) 730
RANKL see receptor activator of nuclear factor κB ligand
RBBSs see resin-bonded bridges
recall schedule, prognosis 959
receptor activator of nuclear factor κB ligand (RANKL)
jaw tumors and cysts 188–189
mononuclear osteoclast progenitors
RANKL-induced differentiation 177–181
tooth eruption 189
tooth movement 189–190
reduced enamel epithelium, developing teeth 71, 74, 105
regeneration
oral tissues 66–67
prequisites 66–67
regeneration procedure of stem cell–mediated bio-roots 165, 166
regeneration vs repair, wound healing 3
regenerative endodontic procedures (REPs) 684–687, 718–733
aims 732
blood clots 723–724
case selection 727, 730
clinical considerations for regenerative endodontic procedures 722–724
clinical REP technique 730–731
cohort studies 724–728, 728
coronial seal 724
definition 719
difficulties with technique 733
discolorations of enamel 730
infection of the root canal system 722–723
follow-up 730
future 732
histologic characterization of tissues formed in the canal space 719–721
history 721–722
implication of SCAP 146–149, 148, 149, 155
infra-canal medicaments 723
minimal or no instrumentation of the dentinal walls 722
outcome assessment 724–728, 724–727, 728
protein scaffolds 723–724
publication bias, outcome assessment 731–732
radiographic responses 730
regeneration vs repair 719
revascularization 729–730
technique 730, 732–733
teeth strength 731
termiology 721
young patients 722
regenerative phase, wound healing 5–7
regenerative potential of GMSCs in vivo 154–155, 156
registration, traumatic dental injuries 252–260, 281
remodeling of jaw bones, osteoclasts 187
remodeling phase, wound healing 8, 37–39
repair, oral tissues 66
repair-related resorption (surface resorption) 428–430, 431, 432, 433, 434
avulsion injuries 492–493
healing complications 134, 135
primary teeth injuries 580–581
repair vs regeneration, wound healing 3
reparative dentin formation, role of DPSCs 142–144, 145, 155
repeated episodes, traumatic dental injuries 264
replacement resorption (ankylosis-related resorption) 430, 432, 433, 434
healing complications 134, 136
periodontal healing 513–515, 514, 515
periodontal ligament (PDL) 83–84, 85
replacement resorption (root canal ankylosis) 434, 435
replantation and avulsion 126–129, 486–518, 498, 508, 519, 771, 775, 786–787
antibiotics 128
procedure 498
treatment delay 129
repositioning
clinical studies 125
experimental studies 125
role 125, 126, 129
REPs see regenerative endodontic procedures
resin-bonded bridges (RBBSs) 824–832
advantages/disadvantages 824–826
complications 831
dental ceramic 826–828
prognosis 829–831
types 824–828
avulsion injuries 627, 629, 640–642
countinuous injuries 626, 628, 631
equipment management 627–624
etiology 626
foreign bodies 629, 630
frequency 626
lacerations 626, 629, 631–640
lips 626, 627
scar 626, 628
systematic approach 627–629
terminology 626
tetanus prophylaxis 643
type 626–627, 644
wound closure materials and principles 640, 642
space closure
see also orthodontic space closure
avulsion injuries 764–767, 772, 786
space loss after premature tooth loss, primary teeth injuries 581, 582
specificity, examination and diagnosis of traumatic dental injuries 301
speech problems due to early loss of primary incisors 581–582
sphingosine-1-phosphate (S1P), osteoclasts 182
splinting 962–970
alveolar bone fractures 969
arch bar splint 963, 964
arch bar splint with acrylic 963
autotransplantation 969
avulsion and replantation 126–127
avulsion injuries 501, 502, 503, 504, 506, 969
composite splint 963, 964
duration 968–969, 969, 970
effects 126–127
enamel changes 962–963
extrusion 968
fixation periods 968–969, 969, 970
flexible wire-composite 963, 964
gingiva influence 962
intrusive luxation 969
lateral luxation 968–969
Luxatemp 963, 964–968
mandible or maxilla fractures 543–544
mechanical properties of splints 963–968
methods 963
orthodontic splint 963, 964
periodontal healing 125–126, 512, 962
periodontal ligament separation and crushing injury (avulsion and replantation) 126–127
periodontal ligament separation injuries (extrusion) 126
prefabricated metal splinting materials 968
primary dentition 969
properties 970
Protemp 963, 964–968
pulp healing 127, 962
recommendations for splinting type and duration 968–969
removable splints 968
requirements 963
resin splints 963, 964–968
rigid wire-composite 963, 964
role 125–127, 129
root fractures 969
suture splint 963, 964
TTS splint 963
types 963–968, 970
spontaneous re-eruption, intrusive luxation 474, 474
Sports activities
economic aspects of traumatic dental injuries 983
information on traumatic dental injuries 993
mouthguard 948–949, 951
statistical considerations
actuarial statistics 956–958
prognosis 955–960
stem cell-based tissue engineering and functional bio-root regeneration 165, 166
stem cell-mediated bio-root regeneration 162–165
in miniature pig models 163–165
stem cells 139–156
biofactors and cell sheets 163, 164
bio-root regeneration 162–165
categories 139
definition 139–140
dental follicle stem cells (DFSCs) 155
dental pulp stem cells (DPSCs) 142–144, 162
derivation of differentiated tissues and organs 141
differentiation 145, 155
gingival mesenchymal stem cells (GMSCs) 154–155, 156
hydroxyapatite/tricalcium phosphate (HA/TCP) scaffolds 163
mesenchymal stem cells (MSCs) 140–142, 147, 150, 154, 155, 162
non-dental stem cells 163
periapical follicle stem cells (PAFSCs) 162–163
periodontal ligament stem cells (PDLSCs) 149–153, 155–156, 162
properties 139–140, 155
scaffolds 163
stem cells from apical papilla (SCAP) 144–149, 155, 162
treated dentin matrix (TDM) scaffold 163
types 139–140, 155
wound healing 3
stem cells from apical papilla (SCAP) 144–149, 155
bio-roots 162
characterization of SCAP in vitro 146
implication of SCAP for regenerative endodontics 146–149, 148, 149, 155
localization of SCAP in vivo 144–145, 146
stratified analysis, prognosis 955
stomatal cell-derived factor 1 (SDF-1), osteoclasts 182
subluxation see concussion/subluxation
summary of treatment and follow-up procedures 1024
supporting bone, classification of traumatic dental injuries 253, 256, 281
supporting bone injuries 529–551
see also specific bones
clinical findings 529, 530, 548
etiology 529, 548
frequency 529, 548
history 548
mandible or maxilla fractures 540–548
pathology 536, 550
prognosis 544–545
pulp necrosis 551
radiographic findings 530–536, 548, 549–550
terminology 529, 548
treatment 536–540, 541–542, 550
surface resorption see repair-related resorption
surgical extrusion, intrusive luxation 477, 478–479
surgical repositioning, intrusive luxation 477, 478–479
survival, tooth see tooth survival
sutures
wound closure materials and principles 640, 642
wound healing 44
systemic administered antibiotics and periodontal healing 128
tartrate resistant acid phosphatase (TRAP), osteoclasts 177
TDIs see traumatic dental injuries
teachers, information on traumatic dental injuries 994
teeth with developed roots 77–92
alveolar bone and marrow complex 86–92, 86, 87, 88
cementum-periodontal ligament complex 79–86, 80
gingival and periosteal complex 77–79
periodontal ligament (PDL) 79–86, 80
periosteum 77–79
response to infection 79
response to trauma 78–79
tetanus prophylaxis, soft tissue injuries 643
tetracycline
periodontal ligament (PDL) 205–206
TGFs (transforming growth factors), wound healing 15, 16
thermal pulp testing
carbon dioxide snow 304
 dichlor-difluormethane 304
 ethyl chloride 304
evaluation and diagnosis of traumatic dental injuries 303–304, 320
heated gutta-percha 303
ice 303, 304
tissues and compounds, wound healing 9–13
tissue storage medium
healing optimization 210–211
ViaSpan® 210–211, 213
titanium mesh, implant therapy 895
toddlers
psychological development stage 229–230
psychosocial aspects of traumatic dental injuries 229–230, 233
treatment plan 233
tongue lacerations 640, 641, 644
tooth eruption
osteoclasts 189
receptor activator of nuclear factor κB ligand (RANKL) 189
tooth fractures see fractures…
tooth movement
osteoclasts 189–190
receptor activator of nuclear factor κB ligand (RANKL) 189–190
tooth resorption, osteoclasts role 191
tooth survival
extrusive luxation 465
intrusive luxation 477–482, 482, 483
lateral luxation 465
root fractures 405, 407
tooth survival and tooth loss
avulsion injuries 507
healing complications 136
predictors 137, 137
topically administered antibiotics and periodontal healing 128
topical oxygenation, wound healing 42
Tøreskog/Myrin concept, esthetics 930
traffic accidents
etiology of traumatic dental injuries 270
mouthguards 950–951
transforming growth factors (TGFs), wound healing 15, 16
TRAP (tartrate resistant acid phosphatase), osteoclasts 177
trauma-related pulp disease 648
traumatic dental injuries (TDIs)
classification 252–260
core outcome set (COS) 258–260, 281
diagnosis 718–733
distribution by sex, age, ethnicity and socioeconomic status 264–265, 282
epidemiology 260–266
etiology 266–273, 280, 282
field screening classification 252, 257
future models 281, 282
incidence 262–263, 265, 282
mechanisms of traumatic dental injuries 274–276, 274, 278–280, 282
organization of emergency care 279–281, 282
place of injury 266
predisposing factors 265–266, 282
prevalence 261–262, 263, 281
prognosis 955–960
psychosocial aspects 227–237
psychosocial impacts 227–229
registration 252–260, 281
repeated trauma episodes 264, 282
seasonal variations 266
teeth involved 266
treatment need 278–279
trends 263–264, 282
types of injuries 266
wound healing 1–2
treated dentin matrix (TDM) scaffold, bio-roots 163
treatment assessment
bio-roots 165–166
psychosocial aspects of traumatic dental injuries 230–231
treatment delay
alveolar process fractures 129
avulsion and replantation 129
complicated crown fractures (enamel-dentin fractures with pulp exposure) 128
crown-root fractures 129
enamel-dentin fractures 129
enamel-dentin fractures (uncomplicated crown fractures) 128
enamel-dentin fractures with pulp exposure (complicated crown fractures) 128
examination and diagnosis of traumatic dental injuries 318–320
luxation injuries 129
mandibular fractures 129
primary teeth injuries 129
pulp canal obliteration (PCO) 428
replantation and avulsion 129
role 128–129
root fractures 129
treatment need, traumatic dental injuries 278–279
treatment plan 231–237
child patients 231–234
emergency treatment 231
injury event 231
orthodontic treatment 753–758, 758
psychosocial aspects of traumatic dental injuries 231–237
treatment strategies, healing optimization 203–204
trends, traumatic dental injuries 263–264, 282
unfavorable healing, healing type 202–203
univariate analysis, prognosis 955
vascular endothelial growth factor (VEGF), wound healing 16, 17
vertical augmentation techniques
alveolar distraction osteogenesis 901–902
staged vertical bone augmentation 901
vestibular lacerations 631, 634
vestibular root angulation, developing teeth injuries 602–605, 606, 618
ViaSpan®
healing optimization 210–211
tissue storage medium 210–211, 213
‘vitality testing’ 302
withdrawn patients, prognosis 958
Wnts
osteoclasts 179–181, 191
RANKL-induced differentiation of mononuclear osteoclast progenitors 179–181
root resorption 191
wound closure materials and principles 640, 642
wound contraction, wound healing 8
wound healing 1–46
acetylcholine 14
adult wound healing 44–45
age influence 44–45
alcohol 43
angiogenesis 17, 31–35, 32, 33, 34
angiogenesis/neovascularization 7
blood circulation 41–42
bone morphogenetic proteins (BMPs) 16, 17
bradykinin 14
cell cycle 3–4, 4
cell differentiation 3
cells involved 1, 2, 19–31, 46
cellular components and mediators 5, 6
chondroitin sulfate proteoglycans 13
colagulation 9–11, 10
colagulation cascade 9–11, 10
collagen 35–39, 36
complement system 13
compounds and tissues 9–13
definition 1
delayed primary closure 9
distant wound response 44
dynamics of wound repair 4–8
enamel matrix proteins (EMPs) 16, 17
endothelial cells 31
epidermal growth factor (EGF) 15–16, 16
epinephrine 14
epithelial cells 38–39
epithelialization 7–8
erthrocytes 20
factors affecting 41–45
fetal wound healing 44
fibrin 3, 6, 7, 10, 11–12, 12
fibroblast growth factors (FGFs) 16, 17
fibroblasts 29–31, 29–30
fibronectin 4, 5, 7, 11–13
fibroplasia (proliferative phase) 5–7
foreign bodies 43–44
general steps 46
growth and differentiation factor 5 (GDF-5) 16, 17
growth factors 14–19, 16
healing process 1–2
hemostasis phase 9–11
heparin and heparan sulfate proteoglycans 13
histamine 13–14
Hunt flow diagram 3, 3
hyaluronic acid and proteoglycans 13
hyperbaric oxygenation 42–43
hypertrophic scar and keloid 37–38
infection 43, 45
inflammation phase 5, 6
inflammatory phase mediators 13–14
insulin-like growth factor (IGF) 16, 17
lymphocytes 26–29, 27–28
macrophages 24–26, 25
mast cells 20, 22
matrix 13
mediators with chemotactic effects 14
microenvironment 39–41
necrotic cells 13
neovascularization/angiogenesis 7
neurotransmitters 14
neutrophils 20–24, 22, 23
norepinephrine 14
optimizing oral wound healing 45–46
oxygenation 41–43
pericytes 31
platelet-derived growth factor (PDGF) 15, 16
platelet-rich plasma (PRP) 15, 16
platelets 19–20, 21
primary healing 8
proliferative phase (fibroplasia) 5–7
proteoglycans and hyaluronic acid 13
regeneration vs repair 3
regenerative phase 5–7
remodeling phase 8, 37–39
repair vs regeneration 3
scar contracture 8
secondary healing 8–9
sequence of events 1–2
serotonin 14
smoking 43
stem cells 3
sutures 44
tissues and compounds 9–13
topical oxygenation 42
transforming growth factors (TGFs) 15, 16
traumatic dental injuries 1–2
types of wound 8–9
vascular endothelial growth factor (VEGF) 16, 17
wound closure materials and principles 640, 642
wound contraction 8
wound healing biology 1–4
wound healing events 8–9, 9
wound healing module 40–41, 40
wound strength development 35–37, 36
wound types 8–9
wounds in skin and oral mucosa, growth factors 17–18
young patients
see also adolescence (13–20 years); child patients; child physical abuse and neglect; preschool childhood (3–5 years); primary teeth injuries; school age (6–12 years); toddlers
ankylosis 836
autotransplantation 884–886
fixed prosthetics 923
growth of the anterior maxilla 878–879, 880, 881
growth status of the patient 886
implant treatment planning 882–886
orthodontic space closure 879–882, 883, 886
prosthetic alternatives in the early mixed dentition 879, 882, 886
regenerative endodontic procedures (REPs) 722
strategies for treatment of tooth loss 878–886