Index

A
AAD. See Atlantoaxial disruption
ABL. See Axis-basion interval
AD. See Autonomic dysreflexia
AIS. See ASIA Impairment Scale
AIT-082. See Leteprinim
reliability
interrater, 271–273, 272t
intra-rater, 271–273, 273t
and Subaxial Cervical Spine Injury Classification Scale, homologous categories, 273, 273t
validity, 271–273
Allied health professionals
in acute care for spinal cord injury, 71–74
in long-term care for spinal cord injury, 74–76
in specialized spinal cord injury rehabilitation center, 76
Alpha-adrenergic receptor agonist
for neuropathic pain, 474–477, 476t
GRADE recommendation for clinical use, 482–483, 482t
for spasticity, 480t, 481–482
American Spinal Injury Association. See also ASIA Impairment Scale
classification system, 63–66, 64f, 65f
prognostic significance, 66–69, 68r–69r
neurological assessment, 63–66
Ami-triptyl ine, for neuropathic pain, 465–467, 466t, 472–476, 473t
Anatomy
of adult spine, 43–49, 43f–44f
of pediatric spine. See Pediatric patients
Ankylosing spondylitis
clinical features, 311
definition, 311
epidemiology, 311
epidural hematoma in, 305f, 312
morbidty and mortality in, 312
spinal cord injury in, 312
spinal fractures in, 311–312
imaging, 305f, 306f, 312
management, 305f, 312–316, 313f, 314r–316r
spinal cord distraction injuries in, 295–318
distraction-extension, mechanism of injury in, 295, 295f
distraction-flexion, mechanism of injury in, 295, 295f
thoracolumbar hyperextension fractures in, 391–396, 392f, 393r–394r, 395r
Thoracolumbar Injury Classification and Severity Score and, 412
Anterior cord syndrome, 285, 299, 300f
Anticholinergics
adverse effects and side effects, 458
oral, for detrusor hyperreflexia/overactivity, 457–458, 457t
Anticonvulsants
adverse effects and side effects, 477–478
mechanism of action, 477
for neuropathic pain, 474r–476t, 477–478
GRADE recommendation for clinical use, 482–483, 482t
Antidepressants, for neuropathic pain, 472–476, 473t
GRADE recommendation for clinical use, 482–483, 482t
Antiglutamatergic agent, for acute spinal cord injury treatment, clinical trials, 540r– 541–542
AO classification system, 24, 130, 267, 268t, 337, 345, 400–401, 403f–404f
AOD. See Atlanto-occipital dissociation
AS. See Ankylosing spondylitis
ASIA Impairment Scale, 63–66, 539, 539t
Athlete(s)
burners in, 204, 204t
spine injuries in
classification, 202, 203r
clinical features, 202–205
diagnostic features, 202–205
emergency stabilization and transport for, 205
epidemiology, 201–202
initial management, 205
prevention, 205–206
rehabilitation for, 206
Athlete(s) (Continued)
and return-to-play, 201, 202t, 207, 207t
surgical treatment, 205
types, 201, 202t
neurapraxia in, 203–204
spear tackler spine in, 205
spinal cord concussion in, 203–204
stingers in, 204
ATI-355, for acute spinal cord injury, clinical trial, 544t,
546–547
Atlantoaxial disruption, 214, 215. See also Craniocervical dissociation
classification, 215
mechanism of injury in, 216–217, 216f
Atlantoaxial facet joints, functional anatomy, 214
Atlantoaxial instability
developmental disorders and, 43
measurement techniques for, 122
Atlantoaxial subluxation
in pediatric patients, 147
closed reduction for, 195
rotatory, closed reduction for, 195
Atlantodental articulation, functional anatomy, 214
Atlantooccipital dislocation, diagnosis, X-line method for, 128
Atlanto-occipital dislocation, in pediatric patients, 147
Atlanto-occipital dissociation, 214, 215.
See also Craniocervical dissociation
classification, 215
diagnosis, 217–219, 218f, 219f–220f
epidemiology, 215–216
mechanism of injury in, 216–217, 216f
in pediatric patients, 147
prognosis for, 219
Atlanto-occipital instability, developmental disorders and, 43
Atlas (C1). See also Craniocervical disruption
anatomy, 43–45, 44f
burst (Jefferson) fracture, measurement technique for, 122, 122f
congenital malformation, 43
functional anatomy, 214
pediatric, 136, 137f
Atropine, intravesical, for detrusor hyperreflexia/
overactivity, 458
Autonomic dysreflexia, 75, 453–464
abdominal pathology and, 456
bladder distension and, 455
blood pressure elevation in, 454
causes, 456, 462
less common, 456
Charcot disease of spine and, 485, 487
fetal impaction and, 456, 457t
fractures and, 456
incidence, 454, 454f
in acute phase of injury, 453
level of injury and, 453
literature review, 453–454
pathophysiology, 453
patients at risk for, 453
pregnancy and labor and, 462, 462t
prevention, 456, 462–463
signs and symptoms, 454
toenail problems and, 456
treatment, 454–455
optimal, 462
pharmacologic, 455–456, 455f–456
physical measures, 454–455
triggers, 453
urologic causes, 455
Axis (C2)
anatomy, 43–45, 44f
injuries. See also Craniocervical disruption
epidemiology, 249
pediatric, 136, 137f
traumatic spondylolisthesis. See also Hangman’s fracture
angulation in, measurement, 123, 123f
associated variants, epidemiology, 249
classification, 249, 250f
clinical features, 249
complications, 252–253
diagnostic features, 249
imaging, 249
literature review, 248–249, 253–257, 254–257
management, 248–262
recommendations, 259–261, 261t
measurement, 123, 123f
neurologic damage with, 249
nonoperative management, 249–250
rehabilitation for, 253
surgical treatment, 250–251, 251f–252f
anterior approach, 250–251, 251f–252
complications, 252–253
posterior approach, 251, 252f–253f
translation in, measurement, 123, 123f
Axis-basion interval, 217. See also Basion-posterior axial line interval
Axonal regeneration and repair. See also Regeneration and repair strategies
biomaterials for, 523
emerging concepts in, 516, 517t, 519–520
failure, after CNS injury, 519
gene expression and, 519
guidance channels for, 523
inhibitory molecules and, 519
scaffolds for, impregnated with therapeutic cells, 523

B
Baclofen
adverse effects and side effects, 458
intrathecal
complications, 481
discontinuation, complications, 458
mechanism of action, 481
for spasticity
GRADE recommendation for clinical use, 482t, 483
intrathecal, 478t–480t, 481
oral, 478t, 481
BAER. See Balloon-assisted end plate reduction
BAl. See Basion-posterior axial line interval
Balloon-assisted end plate reduction
rationale for, 500–501
for thoracolumbar fractures, technique for, 501–503
Balloon dilatation, for detrusor-external sphincter
dyssynergia, 460
Balloon kyphoplasty
cement leakage in, 420, 422
clinical trials, 420, 421t, 422t
complications, 420–423
for osteoporotic thoracolumbar fractures, 415, 416
and adjacent-level fractures, 420–422
cement for, 419–420
and cement leakage, 420, 422
complications, 420–423
computer-assisted fluoroscopic navigation in, 419
eggshell procedure, 419
indications for, 416
and infection, 422–423
open anterior approach, 419
open unilateral interlaminar approach, 419, 420f
percutaneous bilateral transpedicular approach,
417, 418f
percutaneous unilateral extrapedicular approach,
419, 419f
technique for, 417–420
versus vertebroplasty, 416
Balloon vertebroplasty, 500
with short-segment pedicle screws. See Balloon-assisted
drae plate reduction
for traumatic fractures, 500
literature review
results, 502t, 503
strategy, 503
recommendations, 503
Bamboo spine, 311
Basion-axial interval, 128
Basion-dens interval, 121, 122f, 128. See also Dens-basion
interval
Basion-posterior axial line interval, 121, 122f
BC:AO ratio. See Power ratio
BCl. See Brain–computer interfaces
BDL. See Basion-dens interval
Bed rest, 353
Bioengineering, and spinal cord injury repair, 523
Biologics, use of, 35–36
Biomaterials, and spinal cord injury repair, 523
BKP. See Balloon kyphoplasty
Bladder
distension, and autonomic dysreflexia, 455
neurogenic. See Neurogenic bladder
Bladder care, spinal cord injury and, 75
Bladder leak point pressure
and prevention of autonomic dysreflexia, 456
and upper tract damage, 456
Blood pressure
elevation, in autonomic dysreflexia, 454
management, after spinal cord injury, 79
BMD. See Bone mineral density
BMSCs. See Bone marrow stromal cells
Bone
cortical (cancellous), 414
homeostasis, 414
remodeling, 414–415
trabecular, 414
Bone marrow stromal cells, transplantation therapy,
for spinal cord injury, 522–523, 544t, 545f,
548–549
Bone mineral density
measurement, 414
in osteopenia, 414
in osteoporosis, 414
Botulinum toxin
for detrusor hyperreflexia/overactivity, 458, 459t
for spasticity, 480t, 482
Bowel. See also Fecal impaction
management, 461–462, 461t
neurogenic. See Neurogenic bowel
Braces/bracing, 196–198
for osteoporotic compression fractures, 353
for thoracolumbar burst fractures, 369–370
Brain–computer interfaces, 536
invasive, 536
noninvasive, 536
Brown-Séquard syndrome, 299, 300f
Bulbocavernosus reflex, 55–56
Burner(s), 204, 204f
Burst fractures
C1 (Jefferson), measurement technique for, 122, 122f
definition, 369
minimally invasive posterior treatment, 505–510,
506f–512f
neurologically intact, optimal surgical approach
for, 376–380
pathology, 369, 370f
stable, 369, 370f
optimal nonoperative management, 380
subaxial cervical, 269, 269f, 280–283
clinical features, 280–281
complications, 281–282
diagnostic features, 280–281
epidemiology, 280
imaging, 280–281
initial management, 281
literature review, 282–283, 282t
mechanism of injury in, 280
nonoperative management, 281
optimal treatment, 283
rehabilitation after, 282
surgical treatment, 281–283
Burst fractures (Continued)  
- threshold for surgical intervention, 283  
- treatment recommendations for, 283  
- thoracolumbar, 501  
- balloon-assisted end plate reduction for  
- rationale for, 500–501  
- technique for, 501–503  
- management, 369–382  
- treatment, 501  
- vertebroplasty for, 501  
- unstable, 369, 370f  

BVP. See Balloon vertebroplasty  

C  
- Calcium, deficiency, and osteoporosis, 414–415  
- Calcium phosphate cement, 417  
- for balloon kyphoplasty, 419–420  
- in vertebroplasty, 415, 501, 502r, 503  
- recommendations, 503  
- Canadian C-spine rule, 34, 112–113, 113f  
- Capsaicin, intravesical, for detrusor hyperreflexia/overactivity, 458, 458t  
- Captopril, for autonomic dysreflexia, 455t–456r, 456  
- Carbamazepine, for neuropathic pain, 474t  
- GRADE recommendation for clinical use, 482–483, 482t  
- Cardiovascular care, spinal cord injury and, 75–76  
- Case control studies, 6–7  
- Case report(s), 6  
- Cauda equina, anatomy, 433, 433f  
- Cauda equina injuries  
- clinical presentation, 433, 434f  
- injury patterns, 434  
- literature review, 435  
- nonoperative management, 434–436, 436t  
- recommendations for, 438–439  
- surgical treatment, 434–436, 436t  
- approach for, 436–438, 437t  
- direct decompression in, 436–438, 437t  
- recommendations for, 438–439  
- timing of surgery in, 436–438, 437t  
- CCD. See Craniocervical dissociation  
- CCI. See Cranial-C1 interval  
- CD11d/CD18, selective blockade, for reduction of secondary  
- injury in spinal cord injury, 518  
- CEIs. See Cauda equina injuries  
- Cell transplantation, for treatment of acute spinal cord  
- injury, 520–523, 544r, 547–549  
- Cement. See also Calcium phosphate cement;  
- Polymethylmethacrylate cement  
- leakage  
- in balloon kyphoplasty, 420, 422  
- in kyphoplasty, 362–363  
- in vertebroplasty, 362–363  
- Central cord syndrome, 284, 285, 308–309, 309f  
- surgical decompression of, clinical trial, 543–545, 544r  
- traumatic, secondary to cervical spondylosis.  
- See Traumatic central cord syndrome  
- Central pattern generator, 527–528  
- Cerebrospinal fluid, drainage, as neuroprotective strategy,  
- clinical trial, 545  
- Cervical collar, 196–197, 196f, 197f  
- Cervical fractures  
- in ankylosing spinal disease, 305f, 311–316, 313f,  
- 314t–316t  
- in athletes. See Athlete(s)  
- burst, closed reduction for, 195–196  
- flexion teardrop, closed reduction for, 195–196  
- minimally invasive posterior treatment  
- Brain Tumor Study Group recommendations for, 514  
- literature review  
- results, 513t, 514  
- strategy, 511–512  
- missed diagnosis, 188  
- surgical treatment, timing of surgery in  
- and length of stay, 162–163  
- and neurological recovery, 163  
- Cervical spine. See also Subaxial cervical spine  
- clearing, in trauma patient, 109–116  
- with alert and cooperative patient, 109–114,  
- 110r–111t  
- with imaging, with alert and cooperative patient,  
- 110r–111t, 113–114  
- literature review, 109, 110r–112t  
- with obtunded patient, 111r–112r, 114–115  
- recommendations for, 115  
- without imaging, with alert and cooperative patient,  
- 109–113, 110t  
- congenital malformations, 42–43  
- four-column model, 266, 275, 276f  
- injuries  
- anatomical distribution, age and, 215  
- in athletes. See Athlete(s)  
- classification systems, 266–267, 275. See also Cervical  
- Spine Injury Severity Score  
- epidemiology, 215, 249, 285  
- health care costs, 266  
- initial management, 281  
- in pediatric patients, 147  
- sports-related. See Athlete(s)  
- surgical treatment, timing of surgery in,  
- 162–163  
- instability, 267, 267t  
- lower. See also Subaxial cervical spine  
- injuries  
- measurement, 123–124  
- nomenclature, 123–124  
- instability, diagnostic checklist for, 128, 128t  
- stability, determination, 128–129  
- motion, 46–48, 47f  
- pediatric, 136, 137f, 146  
- instrumentation, principles, 150–154  
- stability  
- determination, 127–129  
- quantification system for, 266
stenosis, congenital, 43
injuries. See also Cranio cervical disruption epidemiology, 215
image measurement techniques for, 121–123
nomenclature for, 121–123
stability, determination, 127–128, 127f
Cervical Spine Injury Severity Score, 267, 275–279
and anterior plate fixation, 276, 278f
correlation with AO classification scores, 276
literature review, 275, 276t
and prediction of surgical approach, 276, 277f
reliability, 276, 277t, 279
scoring using, 275–276, 276f
validity, 276–279, 279r
Cervical whiplash injury. See Whiplash
Cervicothoracic junction, injuries associated injuries, 338
classification, 337
clinical features, 337–338
epidemiology, 337
imaging, 337–338, 339–340, 340t
incidence, 337
neurological damage with, 338
nonoperative management, 338
surgical treatment, 338–339
approach for, 339, 340t
complications, 339
Cethrin, 520
for acute spinal cord injury, clinical trial, 544t, 547
Chance fractures, 383
pediatric, 140–144, 143f–144f
Charcot disease of spine
etiology, 485
posttraumatic, 485–490
clinical features, 485–486, 486f, 487f, 488
complications, 486–487, 488, 489
CT appearance, 486, 487f
differential diagnosis, 486
epidemiology, 488
infected, 486, 488
literature review, 488
management
operative, 486f, 487–488, 487f, 489–490
postoperative complications, 489
Spine Trauma Study Group recommendation, 489–490
summary, 489–490
MRI, 486
nonoperative management, 486–487, 489
pathophysiology, 485, 486f
radiographic findings in, 485–486, 486f
rehabilitation for, 489
surgical treatment, approach for, 489
CHART. See Craig Handicap Assessment and Reporting Technique
Child(ren). See Pediatric patients
Chondroitinase ABC, and promotion of axonal repair after spinal cord injury, 519–520
Chondroitin sulfate proteoglycans, and axonal repair after spinal cord injury, 519–520
Clinical research
in acute spinal cord injury, 539–552
trends in, 31–32
Clinical trials
for acute spinal cord injury treatment networks, 543
ongoing, 543–549, 544t, 545t
recently completed, 539–543, 540t
lessons from, 542–543, 542t
recommendations for conduct of, 542, 542r
randomized, controlled, 7
Clonidine
for neuropathic pain, 474t, 477
epidural, 474t, 477
intrathecal, 466t, 467, 472, 473t, 474t, 477
with morphine, 466t, 467, 472, 473t
plus intrathecal baclofen, 474t, 477
for spasticity, 480t, 481–482
Closed reduction
for atlantoaxial rotatory subluxation, 195
clinical applications, 192
for subaxial cervical distraction-extension injuries, 310, 311f
for subaxial cervical distraction-flexion injuries, 300–305, 301t–304t, 305f
traction and, 287–288
for subaxial cervical facet dislocation, 192–195, 193f, 194t
Clostridium botulinum, C3 enzyme, and targeting of Rho/ROCK signaling in spinal cord injury, 520
CMLs. See Conus medullaris injuries
Cobb angle, 22, 22f
Cock-robin appearance, 195
Cohort studies, 7
Compression fractures, 352
burst (A3), 352
epidemiology, 352
etiology, 352
impaction (A1), 352
end plate (A1.1), 352
vertebral body collapse (A1.3), 352
wedge (A1.2), 352
nonoperative management, 353
osteoporotic, 352–353, 414
balloon kyphoplasty for, 415, 416
indications for, 416
and posterior instrumentation, combined, 415–417
technique for, 417–420
versus vertebroplasty, 416
clinical features, 352–353
diagnosis, 415
epidemiology, 352, 415
imaging, 415
kyphoplasty for
adverse effects and side effects, 477
for neuropathic pain, 466t, 467, 475t, 477
GRADE recommendation for clinical use, 482–483, 482t
Leteprinim, for acute spinal cord injury, clinical trial, 544t, 546
Lidocaine
instillation, for urethral procedures, 455
intravenous, for neuropathic pain, 466t, 467, 473t, 474t, 476–477
Life expectancy, after spinal injury, 19, 33–34, 266, 266t
Ligament(s), spinal, anatomy, 45, 46
Lidocaine
for clearing cervical spine, in obtunded patient, 111
of thoracolumbar spine fracture-dislocations, 384, 385f
of thoracolumbar spine flexion-distraction injuries, 384, 385f
of thoracolumbar spine fracture-dislocations, 404–405, 405f
Medical care, improvements in, 18, 18t
Memokath stent, for detrusor-external sphincter dyssynergia, 460–461
Mesenchymal stem cells, transplantation therapy, for spinal cord injury, 522–523
Methylprednisolone
for acute spinal cord injury treatment, 87–90, 88f, 88t, 90f, 135
clinical trials, 540–541, 540t
evidence-based recommendations for, 541, 541t
immunomodulatory recommendations, in spinal cord injury, 518
for spinal cord injury, 518
Mexiletine, oral, for neuropathic pain, 473t, 476
Minimally invasive posterior stabilization
advantages, 505
Brain Tumor Study Group recommendations for, 514
literature review
results, 512–514, 513t
strategy, 511–512
rationale for, 505
technique for, 505–510, 506f–512f
Minimally invasive surgical techniques, 26
Monocycline
for acute spinal cord injury, clinical trials, 544t, 546
immunomodulatory effects in spinal cord injury, 518
plus tacrolimus, for acute spinal cord injury, clinical trials, 545t, 546
Monocytes, activated, in treatment of spinal cord injury, 519
Morphine
epidural, for neuropathic pain, 474t, 477
intrathecal, for neuropathic pain, 466t, 467, 472, 473t, 474t, 477
intravenous, for neuropathic pain, 466t, 467, 472, 473t
plus clonidine, intrathecal, for neuropathic pain, 466t, 467, 472, 473t
Mortality, after spinal injury, 18–19, 21, 22f, 33–34
Motor recovery, versus functional recovery, 471
Motor vehicle accidents, neck pain after, 166, 168–169.
See also Neck pain
MP. See Methylprednisolone
MSCs. See Mesenchymal stem cells
Muscle(s), spinal, anatomy, 45–46, 46f
Myelin, inhibition, and axonal regeneration and repair, 519
Myelin antigens, therapeutic vaccination with, post-injury, 518
Myelin-associated glycoprotein, 546
and axonal repair after spinal cord injury, 519
Myelin-associated inhibitors of axonal repair and regeneration, 519
therapy targeted to, clinical trials, 544t, 546–547
Myelomeningocele, 42
Myotatic reflexes, 53–55, 55f
<table>
<thead>
<tr>
<th>Term</th>
<th>Page Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutrophil(s), post-injury invasion of spinal cord</td>
<td>518</td>
</tr>
<tr>
<td>Nifedipine adverse effects and side effects</td>
<td>456</td>
</tr>
<tr>
<td>for autonomic dysreflexia</td>
<td>455–456, 455t–456t</td>
</tr>
<tr>
<td>Nimodipine, for acute spinal cord injury treatment, clinical trials</td>
<td>540t, 542</td>
</tr>
<tr>
<td>Nitric oxide, for detrusor hyperreflexia</td>
<td>459</td>
</tr>
<tr>
<td>NMDA receptor blockade, for neuropathic pain</td>
<td>474t, 476–477</td>
</tr>
<tr>
<td>GRADE recommendation for clinical use</td>
<td>482–483, 482t</td>
</tr>
<tr>
<td>NMEs. See Neuromuscular electrical stimulation</td>
<td></td>
</tr>
<tr>
<td>Nogo, antibodies for acute spinal cord injury, clinical trial</td>
<td>544t, 546–547</td>
</tr>
<tr>
<td>and axonal repair after spinal cord injury</td>
<td>519</td>
</tr>
<tr>
<td>Nomenclature, for spinal injuries</td>
<td>117–126</td>
</tr>
<tr>
<td>literature review</td>
<td>117–121, 118t–121t</td>
</tr>
<tr>
<td>Nimodipine, for acute spinal cord injury treatment, clinical trials</td>
<td>540t, 542</td>
</tr>
<tr>
<td>NMES. See Neuromuscular electrical stimulation</td>
<td></td>
</tr>
<tr>
<td>NMDA receptor blockade, for neuropathic pain</td>
<td>474t, 476–477</td>
</tr>
<tr>
<td>GRADE recommendation for clinical use</td>
<td>482–483, 482t</td>
</tr>
<tr>
<td>NMEs. See Neuromuscular electrical stimulation</td>
<td></td>
</tr>
<tr>
<td>Nogo, antibodies for acute spinal cord injury, clinical trial</td>
<td>544t, 546–547</td>
</tr>
<tr>
<td>and axonal repair after spinal cord injury</td>
<td>519</td>
</tr>
<tr>
<td>Nomenclature, for spinal injuries</td>
<td>117–126</td>
</tr>
<tr>
<td>literature review</td>
<td>117–121, 118t–121t</td>
</tr>
<tr>
<td>NPCs. See Neural stem/progenitor cells</td>
<td></td>
</tr>
<tr>
<td>NSCs. See Neural stem cells</td>
<td></td>
</tr>
<tr>
<td>Nursing care in acute care for spinal cord injury, 71–74</td>
<td></td>
</tr>
<tr>
<td>in long-term care for spinal cord injury, 74–76</td>
<td></td>
</tr>
<tr>
<td>in specialized spinal cord injury rehabilitation center, 76</td>
<td></td>
</tr>
</tbody>
</table>

**O**

Obesity, Thoracolumbar Injury Classification and Severity Score and, 412

Occipital condyle fractures, image measurement technique for, 122

Occipital injuries. See also Craniovertebral disruption, image measurement techniques for, 121–122

Occipitoatlantal dislocation/dissociation, image measurement techniques for, 121–122

ODI. See Oswestry Disability Index

Odontoid fractures, 229–247

angulation, measurement, 123, 123f

classification, 229

displacement, measurement, 123, 123f

literature review, 229–230, 230f

nonoperative management, 229

in pediatric patients, 147

prevalence, 229, 249

surgical treatment, 229

treatment, options for, 229

type I, definition, 229

type II

anterior vs. posterior fixation for, 230, 235–241, 237t–241t, 245

definition, 229

measurement, 123, 123f

operative vs. nonoperative treatment, 230, 235, 236t–237t, 245

optim treatment for, 230, 235, 236t–237t, 245

type II and III

in elderly, management, 230, 242–245, 242t–244t, 245

nonoperative management, halo vs. brace for, 230–235, 231t–235t, 245

type III, definition, 229
OECs. See Olfactory ensheathing cells
OFS. See Oscillating field stimulation
Olfactory ensheathing cells, in remyelination therapy for spinal cord injury, 521, 544t, 545t, 548
Oligodendrocyte-myelin glycoprotein, 546
and axonal repair after spinal cord injury, 519
Oligodendrocyte progenitor cells, derived from embryonic stem cells, in remyelination therapy for spinal cord injury, 522
OMgp. See Oligodendrocyte-myelin glycoprotein
OPCs. See Oligodendrocyte progenitor cells
Opioid antagonism, for acute spinal cord injury treatment, clinical trials, 540t, 542
Opioids adverse effects and side effects, 472
intrathecal, for neuropathic pain, 472, 473t
for neuropathic pain, 472, 473t
GRADE recommendation for clinical use, 482–483, 482t
oral, for neuropathic pain, 472, 473t
overdose, 472
withdrawal, 472
Orthosis, thoracolumbosacral. See Thoracolumbosacral orthosis
Oscillating field stimulation, clinical trial, 544t, 545t
Osteoblasts, 414–415
Osteoclasts, 414–415
Osteopenia, definition, 414
Osteoporosis definition, 414
fractures caused by, 352–353, 414
diagnosis, 415
treatment, 415–417
medical treatment, 353
pathology, 414–425
physical therapy in, 353
primary, 414
secondary, 414
type I (postmenopausal), 414
type II (age-associated idiopathic), 414
Oswestry Disability Index, 12–13, 16
Outcome assessment based on ASIA score, 66–69, 68t–69t
in evidence-based medicine, 8–9
tools, for spinal trauma patients, 11–17
advances in (future directions for), 14–16
changes (trends in), 36
domains
relevant, 13–14, 15t
specific, 14
generic (general health) instruments, 12
indirect measures, 13
literature review, 11–12
recommendations for, 16
spine-specific instruments, 12–13
trauma-specific instruments, 13
Oxybutynin intravesical, for detrusor hyperreflexia/overactivity, 458
oral, for detrusor hyperreflexia/overactivity, 457–458, 457f
P
Pain compression fractures and, 352–353
neuropathic. See Neuropathic pain
Paraplegia, life expectancy for, 266
Paraplegia, life expectancy for, 266t
Parastep walking device, 534–535, 534f
Parathyroid hormone (PTH), 414
Partial body-weight support treadmill training, 528–529, 529f
Pavlov ratio, 204, 204f
PBWSTT. See Partial body-weight support treadmill training
Pediatric patients atlantoaxial subluxation in, 147
atlanto-occipital dislocation in, 147
cervical spine injuries in, 42, 147
instrumentation for, 150–154
odontoid fractures in, 147
spinal anatomy, 42, 42f, 136, 137f, 146
spinal cord injury in, 135–145
spinal fractures, treatment
literature review, 154, 155t
recommendations, 155
spinal instrumentation in, 146–156
principles, 150–154
spinal maturation in, 42, 42f
subaxial cervical spine injuries in, 147
thoracolumbar injuries in, 147–150
instrumentation for, 154
Thoracolumbar Injury Classification and Severity Score and, 412
Pedicle-laminar fracture-separation injury, 309
Pentagrip, 217
Peripheral neuromuscular blockade, for spasticity, 480t, 482
Physical therapy, for osteoporotic compression fractures, 353
Plain film radiography of cervical spine
in ankylosing spinal disease, 305f, 312, 313f
in brain-injured patient, 188
for clearing cervical spine, in alert and cooperative patient, 110t–111t, 113–114
flexion-extension, for clearing cervical spine in alert and cooperative patient, 111t, 114
in obtunded patient, 111t–112t, 114
of sacral fractures, 441
of subaxial cervical burst fracture, 280
of subaxial cervical flexion-distraction (SLIC distraction-extension) injuries, 286, 286f
of subaxial cervical spine distraction-extension injuries, 308f, 309–310
of subaxial cervical spine distraction-flexion, 300
of thoracolumbar flexion-distraction injuries, 384
of thoracolumbar fracture-dislocations, 404, 405f
of thoracolumbar spine, in emergency setting, 105
diagnostic approaches, 441–442
electrodiagnostic assessment with, 442
H, 442, 443f
insufficiency, 441
Isler classification, 442, 445f
literature review, 444–446
mechanism of injury in, 441
neurological injury with, 441, 442
neurological outcomes with, factors affecting, 444–448
nonoperative management, 443
and surgical treatment, comparison, 448
radiographic assessment, 441–442
Roy-Camille classification, 442, 446f
Strange-Vognonson classification, 442, 446f
surgical treatment, 443–444, 447f
and nonoperative management, comparison, 448
T, 442, 443f
treatment
and neurological outcomes, 446–448
options for, 443–444
timing, and neurological outcomes, 448
U, 442, 443f
Sacral plexus, compression, 441
Sacrum, biomechanical importance, 441
SC.
See Schwann cells
Schwann cells, in remyelination therapy for spinal cord injury, 521, 545f, 548
SCI. See Spinal cord injury
SCI-M. See Spinal Cord Independence Measure
SCIWORA. See Spinal cord injury without radiographic abnormality (SCIWORA)
Scoliosis, congenital, 42–43
Seat-belt (flexion-distraction) injury(ies), 383
associated injuries, 383
pediatric, 140–144, 143f–144f, 149–150
associated injuries, 150
Seat-belt sign, 143, 150, 383
Seat-belt syndrome, 150
Selfotel, 541
Semaphorin 4D, and axonal repair after spinal cord injury, 519
SF-36. See Short Form-36
Short Form-36, 12, 16, 36
Sickness impact profile, 12
SIP. See Sickness impact profile
Skin care, spinal cord injury and, 74
Skin-derived precursor cells, 521
SKPs. See Skin-derived precursor cells
SLIC. See Subaxial Cervical Spine Injury Classification Scale
Smith-Peterson osteotomy, 428–429
Sodium channel blockade, for neuropathic pain, 473f, 476
GRADE recommendation for clinical use, 482t, 483
pharmacological, 478–482, 478t–480t
summary, 482t, 483
Spear tackle spine, 205
Sphincterotomy, for autonomic dysreflexia, in male patients, 459–460, 459f
Spina bifida cystica, 42
Spinal cord
anatomy, 48–49, 48f, 49f
concussion, in athletes, 203–204
embryology, 42
lower thoracic, anatomy, 433, 433f
Spinal Cord Independence Measure, 12, 13, 16
Spinal cord injury, 51, 52f. See also Anterior cord syndrome; Central cord syndrome; Posterior cord syndrome acute conservative treatment, 177
ey early surgical decompression for animal studies, 176, 176f
current studies of, 180–182, 180f–181f, 181f
efficacy, 177–179, 178t, 179t
safety, 176–177, 179t
pharmacological management, 87–91
literature review, 87, 87t, 88t
recommendations for, 90
in ankylosing spondylitis, 312
cardiovascular complications, prevention or management, 75–76
and closed head injury. See also Traumatic brain injury, and spinal cord injury, concomitant management, 185–191
diagnosis, in emergency setting, digital rectal examination for, 51–57
in diffuse idiopathic skeletal hyperostosis, 312
extent of, at admission, trends in, 20
gastrointestinal complications, management, 74–75
genitourinary complications, management, 74–75
hypotension after, prevention, 79
hypothermia treatment, 135–136
immobilization and transfer of patients with, 79–82, 80f, 81f, 82t
initial immobilization and transport after, 79
management evidence-based medicine and, 18–20, 71, 72t–74t
in intensive care unit, 78
See also Traumatic brain injury, and spinal cord injury, concomitant
trends in, 34
missed/delayed diagnosis, 96
in newborn and infant, 136
pathological events in, 516–517, 517t
pathophysiology, 516–517, 517t
pediatric
anatomical considerations, 136, 137f
cervical, 139–140, 139f–140f
prevalence, 471, 472
treatment
GRADE recommendation for clinical use, 482t, 483
pharmacological, 478–482, 478t–480t
summary, 482t, 483
Sphincterotomy, for autonomic dysreflexia, in male patients, 459–460, 459f
Spinal cord injury (Continued)

distribution, by spinal level, 136
epidemiology, 136
mechanism of injury in, 136
seat-belt (flexion-distraction), 140–144, 143f–144f
thoracolumbar, 140, 141f–142f
unexpected clinical presentations, 136
phases, 516–517, 517t
preclinical studies, 135–136
primary, 175
pulmonary complications, prevention or management, 75
secondary, 175–176
prevention, 79
skin complications, prevention or management, 74
in subaxial cervical spine distraction-flexion injury, 299, 300f
surgical decompression, 135
thoracic trauma with, nonoperative management, 82–84
thoracolumbar trauma and, nonoperative management, 82–84
thromboembolic events after, prevention or management, 76
Spinal cord injury without radiographic abnormality
(SCIWORA), pediatric, 136, 137–139, 137f–138f, 146
Spinal injury
clinical research on, 31–32
demographics, 33
epidemiology, 32–34
etiology, 33
global trends in, 31–32
incidence, 33
life expectancy after, 33–34, 266, 266t
mortality rate for, 33–34
risk factors for, global trends in, 32
types, 33
Spinal instability
classification, 130
diagnostic checklist for, 266, 267t
Spinal shock, diagnosis, in emergency setting, digital rectal examination for, 51–57
Spinal stability, determination, 127–131
Spine trauma care systems, 34
Sports. See Athlete(s)
Stabilization. See also Minimally invasive posterior stabilization
early, for spinal fractures in trauma patient, 157–165
animal studies, 158–162, 158t
literature review, 157–158, 157t–162t
outcomes with, 159t–162t, 162–164
for osteoporotic compression fractures, 417
for subaxial cervical spine distraction-flexion injuries, 289, 290f
STASCIS. See Surgical Treatment of Acute Spinal Cord Injury Study
Stem cells
embryonic
NPCs and OPCs derived from, in remyelination therapy for spinal cord injury, 522
transplantation, in treatment of acute spinal cord injury, 544t, 549
induced pluripotent, 522
mesenchymal, transplantation therapy, for spinal cord injury, 522–523
neural, in remyelination therapy for spinal cord injury, 521–522
Stevens-Johnson syndrome, 477
Stiff spine. See also Ankylosing spondylitis; Diffuse idiopathic skeletal hyperostosis
Thoracolumbar Injury Classification and Severity Score and, 412
Stinger(s), 204
Stretch reflex, hyperexcitability, 472
Study(ies)
case control, 6–7
cohort, 7
designs, 5–7
observational, 5–6
retrospective, 7
Subaxial cervical spine anatomy, 267
angular displacement, measurement, 128, 129f
biomechanics, 267
facet fracture/dislocations, 270, 296f, 297, 297f, 298f
imaging, 129
measurement, 123–124, 124f
stability, determination, 129
fractures
in ankylosing spinal disease, 305f, 311–316, 313f, 314t–316t
mechanism of injury in, 280
nonoperative management, 281
optimal treatment, 283
rehabilitation after, 282
surgical treatment, 281–283
threshold for surgical intervention, 283
treatment recommendations for, 283
compression/burst, 269, 269f, 280–283
clinical features, 280–281
complications, 281–282
diagnostic features, 280–281
epidemiology, 280
imaging, 280–281
initial management, 281
literature review, 282–283, 282t
mechanism of injury in, 280
nonoperative management, 281
optimal treatment, 283
rehabilitation after, 282
surgical treatment, 281–283
threshold for surgical intervention, 283
treatment recommendations for, 283
compression/burst, 269, 269f, 280
end plate compression fracture with facet fracture/dislocation, 270
morphology, 267–268, 268t
compression/burst, 269, 269f
distraction, 270
translation/rotation, 270, 271f, 272f
stability, determination, 129
teardrop, 270
extension, 308–309, 308f
flexion, 299
reverse, 308f, 310
Subaxial cervical spine injury(ies)

- translation/rotation, 270, 271f, 272f
- unilateral/bilateral facet fracture dislocations, 270, 284f, 297, 297f, 298f
- vertebral burst fracture/dislocation, 270
- instability, 267, 267t
- diagnosis, 128–129
- checklist for, 128, 128t
- kyphosis, measurement, 124
- ligaments, 266
- motion segments, 267
- overriding facets, 129
- perched facets, 129, 192, 193f, 285
- posterior ligamentous injury, 280–281
- spondylolisthesis, closed reduction for, 195–196
- stability, determination, 128–129
- subluxed facets, 285
- translation in, measurement, 124, 124f, 128, 129f
- vertebral bodies in, 267
- height loss, measurement, 124

Subaxial cervical spine injury classification systems

- anterior plate fixation, CSISS score and, 276, 278f
- classification, 266, 275, 295–296.
- See also Cervical Spine Injury Severity Score; Subaxial Cervical Spine Injury Classification Scale
- classification systems, 266–267
- discoligamentous assessment in, 267–271, 268
- mechanism of injury in, 295, 295f
- mortality after, 307
- neurological damage with, 309, 309f
- nonoperative management, 301
- and vertebral artery injury, 298–299, 299f
- epidemiology, 266, 285, 295, 295f
- health care costs, 266, 266t
- hyperextension, 270, 284, 295f
- epidemiology, 295
- mechanism of injury in, 295, 295f
- hyperflexion, 270, 285
- initial management, 281
- life expectancy after, 266, 266t
- measurement, 123–124
- mechanism of injury in, 266
- patterns, 268–270
- in pediatric patients, 147
- spinal canal compromise in, measurement, 124
- spinal cord compromise/compression in, measurement, 124
- surgical approach for, CSISS score and, 276, 277f
- translation/rotation, 270, 271f, 272f, 346, 347f, 347t
- literature review, 328–329, 331–335t
- subtypes, 327, 328f–330f
- surgical treatment approach for, 327–336
- recommendations for, 329–336, 335f
- Subaxial Cervical Spine Injury Classification Scale, 266–274, 281, 284, 295–296, 337
- components, 267–268, 268t
- discoligamentous assessment in, 267–271, 268t, 284
- injury patterns in, 268–270, 284
- end plate compression fracture with facet fracture/dislocation, 270
- hyperextension, 270, 284
- hyperflexion, 270, 285
- teardrop fracture, 270
- unilateral/bilateral facet fracture dislocations, 270
- vertebral burst fracture/dislocation, 270
- morphology of fracture in, 267–268, 268t, 284
- Allen-Ferguson classification system, homologous categories, 273, 273t
- compression/burst, 269, 269f
- distraction, 270
- translation/rotation, 270, 271f, 272f
- neurological status assessment in, 267–271, 268t, 284
- reliability
- intrarater, 271–273, 272t
- intrarater, 271–273, 273t
- scoring using, 267–268
- translation/rotation injuries in, 270, 271f, 272f
- validity, 271–273
etiology, 352
kyphoplasty for, 353–363, 360t–362r, 362f
complications, 362–363
contraindications to, 362
indications for, 353–361, 363–364
technical aspects, 362
management, 352–368
nonoperative management, 353
in pediatric patients, 148–149, 148f
vertebroplasty for
complications, 362
contraindications to, 362
indications for, 353–361, 363–364
technical aspects, 362
endoscopic treatment, 493–498
anterior approach, 493–498
complications, 494
historical perspective on, 493–494
literature review strategy, 494, 494t
options, 493–494
outcomes with, 496–497t, 497–498
rehabilitation after, 494
Spine Trauma Study Group recommendation, 498
flexion-distraction, in pediatric patients, 149–150
minimally invasive posterior treatment
advantages, 505
Brain Tumor Study Group recommendations for, 514
complications, 511
literature review results, 512–514, 513t
strategy, 511–512
rationale for, 505
rehabilitation after, 511
technique for, 505–510, 506f–512f
missed/delayed diagnosis, 96, 188
nonoperative management, 82–85
case presentation, 84, 85f
recommendations for, 84–85
osteoporotic, 414–426
pathological, nonoperative management, 353
in pediatric patients, 147
surgical treatment
options for, 493–494, 505
timing of surgery in and length of stay, 163
and neurological recovery, 163
types, 500–501
vertebroplasty for, 353–363, 354t–359r, 500–504
rationale for, 500–501
techniques for, 500
Thoracolumbar fracture-dislocations
AO classification, 400–401, 403f–404f
associated injuries, 404
case example, 405f, 407–408, 408f
classification, 400–410
clinical features, 402–404
Denis classification, 400–401, 401f–402f
epidemiology, 400

T
Tabes dorsalis, and spinal neuropathic arthropathy, 485
TAL. See Transverse atlantal ligament
Tamsulosin, oral, for detrusor hyperreflexia/overactivity, 457–458, 457t
TCCS. See Traumatic central cord syndrome
T cells (T lymphocytes), autoreactive, 518
Terazosyn, oral, for detrusor hyperreflexia/overactivity, 457–458, 457t
Tetraplegia, life expectancy for, 266t
Thoracic spine. See also Thoracolumbar fractures, nonoperative management, 82–85
instability, diagnostic checklist for, 129, 129t
pediatric, 136
instrumentation, principles, 154
Thoracolumbar fracture(s)
associated injuries, as potential distraction, 96
balloon-assisted end plate reduction for
rationale for, 500–501
technique for, 501–503
burst, 501
bracing for, 369–370
conservative management, 369–370
management, 369–382
complications, 373–375
literature review, 375–381
recommendation for, 381
minimally invasive posterior treatment, 505–510, 506f–512f
neurologically intact, optimal surgical approach for, 376–380
in pediatric patients, 149, 149f
stable, optimal nonoperative management, 380
surgical treatment, 370–373, 372f–375f, 376t–378t
anterior approaches, 371, 373f–374f
combined anterior/posterior approaches, 371–373
complications, 373–375
optimal approach, 376–380
posterior approaches, 371–373, 372f–375f
classification systems, 147, 345, 369, 371f
compression-type
of anterior column, 500–501
clinical features, 352–353
epidemiology, 352
frequency, by spinal level, 400
imaging, 404–405, 405f
instrumentation for, 406
mechanism of injury in, 400
nonoperative management, 405–406
in pediatric patients, 150, 151f–153f
rehabilitation for, 407
surgical treatment, 406–407
  anterior approach for, 406–407
  complications, 406–407
  lateral extracavitary approach for, 406–407
  optimal approach for, 408, 409t
  optimal timing for, 408, 409t
  recommendations for, 408, 409t
Thoracolumbar injury(ies)
canal total cross-sectional area in, measurement, 23f
classification, 23–24, 25f
  for fracture-dislocations, 400–410
conservative treatment, 24
delayed diagnosis, 96
evidence-based medicine and, 21–28
flexion-distraction
  associated injuries, 383
  biomechanics, 383
  classification, 383–384, 384t
  clinical presentation, 383
  etiology, 383
  evaluation, 383
  imaging, 384, 384f, 385f
  literature review, 385–387, 387t
  outcomes, 385
  rationale, 385
  and neurological deficits, 383
nonoperative management, 384
  vs. surgical treatment, 387–389, 387t
operative treatment, 385, 386f
  fusion in, 387t, 389
Spine Trauma Study Group recommendations, 389
surgical treatment, vs. nonoperative management, 387–389, 387t
hyperextension
in ankylosing spondylitis, 391–396, 392f, 393t–394t, 395f
in diffuse idiopathic skeletal hyperostosis, 391, 393f, 396–398, 397t
in stiff spine, 391–399
imaging, 22
initial treatment, 21–22
instrumentation for, advances in, 24–26
kyphoplasty for, 26
measurement, 22, 22f–23f, 124–125
missed diagnosis, 96
in pediatric patients, 147–150
rehabilitation for, 26
sagittal alignment in, measurement, 22f, 125
sagittal to transverse canal diameter ratio in,
  measurement, 23f
spinal canal compromise in, measurement, 125
surgical treatment, 24
  minimally invasive techniques, 26
  timing of surgery for, 24
vertebral body compression in, measurement, 23f, 125
vertebral body translation in, measurement, 22f, 125
vertebroplasty for, 26
Thoracolumbar Injury Classification and Severity Score,
  23–24, 25f, 384, 384r, 401–402
confounders and, 411–413
and elderly patients, 411–412
evolution, 348–349, 349f
injury morphology in, 346, 347f, 347t, 369, 371t
integrity of posterior ligamentous complex in, 346, 347t,
  369, 371t
literature review, 349, 349t–350r
neurological status in, 347, 347t, 369, 371t
and obese patients, 412
parameters for, 346–347, 347f, 347t, 369, 371t
and pediatric patients, 412
and polytrauma patients, 412
recommendations for, 349, 349t–350r
reliability, 411
and stiff spine, 412
surgical decision-making using, 347–348, 348t,
  369, 402
validation, 348–349, 349f
Thoracolumbar Injury Severity Score, 130, 346
Thoracolumbar spine
anterior column, surgical approaches for, 500
imaging, in emergency setting, 96
indications for, 96–103, 97t–102t
literature review, 96, 97t–103t
recommendations for, 106–107
instability, diagnostic checklist for, 129, 129t
motion, 46–48, 47f
pediatric, instrumentation, principles, 154
stability, determination, 129–131
Thoracolumbosacral orthosis, 197–198, 198f, 370,
  384, 434
Three-column model of spine, 129–130, 147, 369, 371f,
  400, 401f–402f
Thyrotropin-releasing hormone, for acute spinal cord injury
  treatment, 88t, 90
clinical trials, 540f, 541
Tizanidine, for spasticity, 480t, 482
TLICS. See Thoracolumbar Injury Classification and Severity Score
TLISS. See Thoracolumbar Injury Severity Score
TLSO. See Thoracolumbosacral orthosis
Tracheostomy, 75
Transcranial stimulation, for neuropathic pain, 467, 468t
Translation/rotation injury, of subaxial cervical spine, 270,
  271f, 272f, 346, 347f, 347t
surgical approach to, 327–336
Transverse atlantal ligament rupture, 128
  measurement technique for, 128
Trauma care, 34
Traumatic brain injury
  epidemiology, 185
  evaluation of patient with, 185
Traumatic brain injury (Continued)
mechanism of injury in, 185–186
and spinal cord injury, concomitant, 185
case presentation, 189f, 190, 190f
clinical presentation, 187, 187t
imaging, 188
incidence, 186
initial evaluation of patient with, 186–187
mechanism of injury in, 186
spinal levels involved in, 186
treatment, 188–189
types, 185–186
Traumatic central cord syndrome, secondary to cervical
spondylosis, 319–326
case presentation, 319–326
definition, 319
differential diagnosis, 319–320
functional outcomes with, factors affecting, 320
imaging, 319, 319f, 320f, 321f
literature review, 320–321
with multilevel compression and fixed kyphotic
spine, 326
optimal treatment for, 321–322, 322t, 324–325
pathology, 320
prognosis for, 319, 320
risk factors for, 319
subtypes, 319, 319f
surgical treatment
optimal approach for, 322–324, 323t, 325
recommendations for, 325–326
treatment, Spine Trauma Study Group recommendations,
325
Traumatic spondylolisthesis, cervical. See also Axis (C2),
traumatic spondylolisthesis; Hangman’s fracture
closed reduction for, 195–196
TRH. See Thyrotropin-releasing hormone
Tricyclic antidepressants, for neuropathic pain,
472–476, 473t
Trigger voiding, 75
Tumor necrosis factor α (TNFα), in immune response
to spinal cord injury, 518

U
Upper extremity
functional electrical stimulation in, 535
movements, robotically assisted training, 536
Urethral stent, for detrusor-external sphincter
dyssynergia, 460
Urinary catheterization, and autonomic dysreflexia,
455
Urinary drainage, 455

V
VACTERL association, 42
Valproate
adverse effects and side effects, 477
for neuropathic pain, 474t, 477
GRADE recommendation for clinical use,
482–483, 482t
teratogenicity, 477–478
Valsalva technique, for voiding, 75
VAP. See Ventilator-associated pneumonia
Vasculature, spinal, anatomy, 48, 48f
VCF (vertebral compression fractures). See Compression
fractures
Ventilator-associated pneumonia, 75
Ventilator-dependent patient(s), life expectancy for, 266t
Vertebral artery, injury, in subaxial cervical spine injury,
298–299, 299f
Vertebral canal:vertebral body ratio, 203–204, 204f
Vertebral compression fractures.
See Compression fractures
Vertebroplasty, 26
adjacent-level fracture after, 363
cement for, 353, 415–416
leakage, 362–363
recommendations, 503. See also Calcium phosphate
cement; Polymethylmethacrylate cement
complications, 362–363
neurological, 363
historical perspective on, 500
for osteoporotic thoracolumbar fractures,
versus balloon kyphoplasty, 416
for thoracolumbar fractures, 353–363, 354t–359t,
500–504
rationale for, 500–501
techniques for, 500
for traumatic fractures, 500
literature review
results, 502t, 503
strategy, 503
rationale for, 500–501
recommendations, 503
Vesicostomy, cutaneous, for neurogenic bladder, in female
patients, 460
Vitamin D, deficiency, and osteoporosis, 414–415
VP. See Vertebroplasty

W
WADs. See Whiplash-associated disorders
Walking index for spinal cord injury, 12, 13
Wallenburg syndrome, 217
Whiplash [term], 166
Whiplash-associated disorders, 166
acute, optimal management for, 169–171
clinical features, 167
epidemiology, 166
grading system for, 167
nonoperative management, 167, 168t, 170–171, 170t
pathophysiology, 167
prognosis for, 168–169
  factors affecting, 171–172, 172t, 173t
rehabilitation for, 168–169
surgical treatment, 167–168, 168t, 171, 171t
Whiplash injury
  acute
  optimal management for, 169–171
  prognosis for, factors affecting, 171–172, 172t, 173t
clinical features, 166–167
epidemiology, 166
nonoperative management, 167, 168t, 170–171, 170t
surgical treatment, 167–168, 168t, 171, 171t
WISCI. See Walking index for spinal cord injury
World Health Organization (WHO), outcomes assessment tools, 36