

Volume 1

Section 1

1

Principles of the treatment of pelvic ring injuries

1.1	Anatomy of the pelvic ring	3
	Marvin Tile, James F Kellam	
1	Introduction	3
2	Structural stability	3
3	Interior of pelvis	8
4	References	16
1.2	Biomechanics and methods of internal fixation	17
	John T Gorczyca	
1	Introduction	17
2	Anatomical structures	17
3	Concept of pelvic stability	19
4	Injury force patterns	20
5	Biomechanics of pelvic fixation	22
6	Conclusion	35
7	References	36
1.3	Pathoanatomy, mechanisms of injury, and classification	39
	Kelly Lefavre, Peter J O'Brien, Marvin Tile	
1	Introduction	39
2	Pathoanatomy	39
3	Mechanisms of injury	41
4	Classification	47
5	Comprehensive classification	52
6	Type 61-A: stable	53
7	Type 61-B: partially stable	54
8	Type 61-C: completely unstable (Young-Burgess APC III, VS)	55
9	Pelvic ring disruption associated with acetabular fracture	56
10	Conclusion	57
11	References	60

1.4	General assessment and management of the polytrauma patient	61
	Wolfgang K Ertel, James F Kellam	
1	Introduction	61
2	General principles	62
3	Principles of damage control	69
4	Relationship of pelvic fractures to injuries in other systems	71
5	Specific treatment of pelvic disruption in a multiply injured patient	72
6	Control of pelvic hemorrhage	76
7	Definite fracture care in the multiply injured patient	80
8	Conclusion	80
9	References	81
1.5	Defining the injury: assessment and principles of management of pelvic ring fractures	83
	Richard J Jenkinson, Marvin Tile, Joel Rubenstein	
1	Introduction	83
2	Clinical assessment	83
3	Radiographic assessment	87
4	Principles of management of pelvic ring fractures	92
5	References	98

Section 2

Techniques

99

1.6	Surgical approaches to the pelvis	103
	Michael J Weaver, James F Kellam	
1	General considerations	103
2	Approaches to the anterior ring	103
3	Approaches to the posterior ring	108
4	Anterior (intrapelvic) approach to the sacroiliac joint	108
5	Posterior (extrapelvic) approach to the sacroiliac joint and lateral sacrum	110
6	Sacral approach	113
7	References	115
1.7	External fixation of the pelvic ring	117
	Pol M Rommens, Alexander Hofmann	
1	Introduction	117
2	Biomechanical aspects	117
3	Indications	119
4	Application methods	121
5	Pin placement in the iliac crest	123
6	Pin placement in the anterior inferior iliac spine	128
7	Frame design	128
8	Aftercare	129
9	Conclusion	129
10	References	131
1.8.1	Internal fixation of the injured pelvic ring: rationale	133
	Marvin Tile	
1	Introduction	133
2	Benefits of internal fixation	133
3	Risks	135
4	Individual types: rationale	137
5	Conclusion	137
6	References	138
1.8.2	Internal fixation of the injured pelvic ring: navigation	139
	Rami Mosheiff, Meir (Iri) Liebergall	
1	Patient selection and indications	139
2	Preoperative assessment	140
3	Surgical technique	143
4	Principles of navigation and guidance	144
5	Conclusion	151
6	References	152

1.8.3	The management of the injured pelvic ring: internal fixation of stable pelvic ring fractures (type A)	153
	Markku T Nousiainen, Philip A Brady	
1	Patient selection/indications	153
2	Nonoperative management	154
3	Preoperative planning	154
4	Surgical techniques	155
5	Postoperative care	157
6	Results	157
7	Complications	157
8	Conclusion	157
9	References	158
1.8.4	The management of the injured pelvic ring: internal fixation of the anterior pelvic injuries—open book type (B1)	159
	Sean E Nork	
1	Introduction	159
2	Nonoperative management	162
3	Preoperative planning	162
4	Surgical techniques	163
5	Postoperative care	170
6	Results	170
7	Complications	171
8	Conclusion	172
9	References	173
1.8.5	Internal fixation of lateral compression fractures (type B2)	175
	Stephen H Sims	
1	Patient selection and indications	175
2	Nonoperative treatment	176
3	Preoperative planning	177
4	Surgical technique	177
5	Special fracture considerations	181
6	Postoperative care	185
7	Results	185
8	Conclusion	185
9	References	185

Section 3**263****Special indications**

1.8.6	Internal fixation of unstable fractures (types B3 and C)	187
	Milton Lee (Chip) Routt Jr, Timothy S Achor	
1	Patient selection/indications	187
2	Nonoperative management	192
3	Preoperative planning	192
4	Surgical techniques	194
5	Postoperative care	230
6	Results	231
7	Complications	231
8	Conclusion	232
9	References	233

1.9	Sacral fractures	235
	Tim Pohlemann, Jörg H Holstein, Ulf Culemann	
1	Introduction	235
2	Anatomy	235
3	Neurovascular anatomy	236
4	Clinical importance of the sacral anatomy	237
5	Classification	237
6	Incidence and injury mechanism	240
7	Patient selection and indications	241
8	Preoperative planning	244
9	Surgical techniques	244
10	Surgical approaches	248
11	Fracture stabilization and choice of implants	251
12	Completely unstable pelvic ring injury (type C) with major displacement and without neurological deficit	255
13	Postoperative care	258
14	Complications	260
15	Conclusion	260
16	References	261

1.10	Lumbosacral instability and stabilization	265
	Colin V Crickard, Joshua C Patt	
1	Introduction	265
2	Preoperative planning	269
3	Surgical technique	269
4	Decompression technique	272
5	Closure technique	272
6	Postoperative care	273
7	Outcomes	273
8	Conclusion	274
9	References	274

1.11	Open pelvic fracture	275
	Robert V O'Toole, Ted Manson	
1	Introduction	275
2	Classification	275
3	Initial management	276
4	Preoperative planning	277
5	Surgical techniques	278
6	Tips and tricks	282
7	Postoperative care	282
8	Results	283
9	Complications	283
10	Conclusion	283
11	References	284

1.12	Pelvic ring disruption in women: genitourinary and obstetrical implications	285
	Carol E Copeland	
1	Introduction	285
2	The nonpregnant female patient	285
3	The pregnant trauma patient	295
4	Pelvic trauma as a consequence of pregnancy	297
5	Conclusion	301
6	References	302

1.13	Urological injuries in pelvic ring trauma: assessment and management in male patients	305
	Ron Kodama, Raj Satkunasingam	
1	Anatomy and classification	305
2	Bladder injuries	307
3	Pelvic fracture urethral injuries	309
4	Conclusion	311
5	References	312

Section 4**351****Results and complications**

1.14 Injury to the pelvis in pediatric patients: the immature skeleton 313

Theddy Slongo

1	Anatomy and classification	313
2	Patient selection and indications	319
3	Preoperative planning	320
4	Surgical techniques	321
5	Postoperative care	331
6	Results and outcomes	332
7	Complications	334
8	Conclusion	334
9	References	335

1.15.1 Insufficiency fractures of the pelvis: metabolic and nonoperative workup 337

Aasis Unnanuntana, Anas Saleh, Joseph M Lane

1	Introduction	337
2	Etiology and pathogenesis	337
3	Assessment and medical evaluation	338
4	Nonoperative management	342
5	Conclusion	344
6	References	344

1.15.2 Insufficiency fractures of the pelvis: operative management 347

Karen Hand, James F Kellam

1	Patient selection and indications	347
2	Preoperative planning	347
3	Surgical techniques	347
4	Postoperative care	348
5	Conclusion	348
6	References	350

1.16.1 Outcomes after pelvic ring injuries: general concept and conclusion 353

Patrick DG Henry, Richard J Jenkinson, Hans J Kreder

1	Introduction	353
2	Outcomes and complications following pelvic ring injuries	353
3	Injury and treatment factors related to outcome	357
4	Conclusion	358
5	References	359

1.16.2 Outcomes after pelvic ring injuries: critical review of the world experience 361

Axel Gänsslen

1	Introduction	361
2	Health outcomes and management	361
3	Level of evidence and evidence-based practice	363
4	Basis of outcomes evaluation of pelvic ring injuries	363
5	Outcomes after type A injuries	364
6	Outcomes after type B injuries	365
7	Outcomes after type C injuries	368
8	Conclusion	373
9	References	374

1.17 Venous thromboembolism in pelvic trauma 377

William H Geerts

1	Introduction	377
2	Epidemiology of venous thromboembolism in pelvic trauma	377
3	Diagnosis of clinically suspected venous thromboembolism	380
4	Treatment of venous thromboembolism in patients with pelvic trauma	382
5	Prevention of venous thromboembolism in pelvic trauma	383
6	Screening for asymptomatic deep vein thrombosis	388
7	Practical aspects of thrombosis prevention in patients with pelvic fracture	389
8	Conclusion	391
9	References	392

1.18	Complications of pelvic trauma	401
	Andrew Grose, David E Asprinio, Marvin Tile	
1	Introduction	401
2	Early complications	401
3	Late complications	408
4	Conclusion	411
5	References	412

1.19	Malunion and nonunion of the pelvis: posttraumatic deformity	415
	Michael D Stover, William D Lack	
1	Incidence	415
2	Etiology	415
3	Deformity	416
4	Definition	416
5	Symptomatology	416
6	Patient evaluation	419
7	Treatment	420
8	References	423