

OHSU Department of Orthopaedics and Rehabilitation

Rotation Specific Objectives for Resident Education

Rotation: Legacy Emanuel Resident year-in-training: PGY2, PGY4

Attending Physicians:

1. Steven Madey, M.D.

Orthopedic Surgeon, ABOS Board Certified
Fellowship: Hand and Microvascular Surgery

2. Richard Gellman, M.D.

Orthopedic Surgeon, ABOS Board Certified
Fellowship: Trauma, Foot and Ankle

3. Britt Frome, M.D.

Orthopedic Surgeon, ABOS Board Certified
Fellowship: Hand and Microvascular Surgery

4. Corey VandeZanschulp, M.D.

Orthopedic Surgeon, ABOS Board Certified
Fellowship: Trauma

5. Douglas Beaman, M.D.

Orthopedic Surgeon, ABOS Board Certified
Fellowship: Foot and Ankle

6. Amer Mirza, M.D.

Orthopaedic Surgeon, ABOS Board Certified
Fellowship: Trauma, Adult Reconstruction

Primary Objective:

Surgical and medical training related to orthopedic trauma. This includes, but is not limited to, the initial work-up and triage of patients with acute injuries from trauma and post trauma sequelae. At the end of the rotation, the trainee will be able to conduct a history and physical in the initial evaluation of urgent orthopaedic trauma and manage these patients on the ward in the peri-operative period. In addition, the trainee will understand posttraumatic and postoperative sequelae including nonunion and malunion of fractures. Since Emanuel Hospital has additional patient volume in traumatic hand, foot, and ankle injuries and limb deformities, the residents should focus their education on these specific areas of orthopaedic trauma care. Additionally

there is a large volume of geriatric and periprosthetic trauma, and the resident will participate in the care of this unique patient population.

Educational Philosophy:

The principal goal of the orthopaedic trauma service at Emanuel is to familiarize orthopaedic residents with the management of orthopaedic injuries from acute trauma. Most often this trauma is secondary to high energy mechanisms such as motor vehicle crashes, falls and gunshot wounds. An understanding of which injuries need surgical management and an understanding of appropriate nonoperative management of other injuries is mandatory. The ability to triage and plan fracture care for polytraumatized patients is a necessary skill that will be learned on this rotation. Furthermore, the resident should understand varying methods of failure (infection, nonunion, malunion, loosening, etc) and appropriate algorithms of management. Specific surgical management of these problems with multiplanar external fixators and the ilizarov technique will be taught.

Rotation Expectations and Opportunities

The Orthopaedic Residents will work primarily with two Traumatologists and one upper extremity surgeon. There is also opportunity to work with a foot and ankle surgeon and complex arthroplasty surgeon. There is another resident from a neighboring residency in Corvallis who splits time with the two residents from OHSU. Two residents, a pgy2 and pgy4, will spend 10 weeks at Legacy Emanuel, with 3-4 weeks on upper extremity with Dr. Madey, 3-4 weeks with Dr. Gellman, and 3-4 weeks with Dr. VandeZandeschulp. This is a mentorship model. If the resident's primary surgeon does not have cases scheduled there is opportunity to work with Dr Frome (upper extremity), Dr Beaman (foot and ankle) and Dr Mirza (arthroplasty) throughout the rotation. On average, there will be 3-4 OR days per week, 1 day of clinic per week, and ½ day of educational activity / self study (preparing for conferences, review of upcoming cases, independent study). There is call responsibility, one in every 3-4 nights. The resident will be on home call and primary call for the ED as well as the transfer center for surrounding hospitals. There is back up attending call should a patient need to go to the OR.

Madey/Frome

Monday OHSU Grand Rounds, Madey clinic

Tuesday add on cases

Wednesday OR

Thursday OR

Friday resident conference at OHSU, OR

Gellman

Monday OHSU Grand Rounds, OR

Tuesday OR

Wednesday clinic

Thursday OR

Friday resident conference at OHSU, OR

Beaman
Monday OHSU Grand Rounds, OR
Tuesday OR
Wednesday OR
Thursday - clinic
Friday resident conference at OHSU, OR

Vande Zandschulp/Mirza
Mon - OHSU Grand Rounds, OR
Tuesday OR
Wednesday clinic
Thursday OR
Friday resident conference at OHSU, OR

Every Wednesday morning at 6:30am, there is a fracture rounds conference. This is a case based conference consisting of upcoming surgical cases and postoperative cases.

Generalized Rotation Goals & Mechanisms:

Didactic:

- A weekly conference on Wednesday mornings involving the residents / attendings.
- Pre-, and post-rotation meetings to assess expectations and progress of residents.
- Journal Club 2-3x / year to discuss important literature on trauma. This journal club is combined with the OHSU orthopaedic trauma group.

Patient Care

- Manage all aspects of acute trauma seen in patients of all ages. This includes appropriate non-operative treatment modalities along with varying surgical treatment options. The resident is responsible for learning and understanding indications of operative fixation for fractures.
- Attain competence in performing a comprehensive evaluation and examination of new patients seen through the ED. Comprehensive and concise history, physical examination, and diagnostic test ordering and interpretation are emphasized.
- Practice thorough and concise management of post-operative patients during their inpatient stay.

Medical Knowledge

- For each location discussed (list below), the resident should understand the relevant fracture pattern, mechanism of injury, anatomy, and appropriate history and physical exam. Discussion from staff will focus on a case-based learning approach as patients are treated. Questions and answers will most often be covered by simple review textbooks supplemented by the reading list below.
 - Clavicle

- Proximal humerus
 - Humeral shaft
 - Distal humerus
 - Fractures about the elbow (terrible triad, radial head, olecranon)
 - Forearm shaft
 - Distal radius
 - Scaphoid, carpal instability, phalangeal, metacarpal
 - Pelvic ring
 - Acetabulum
 - Proximal femur
 - Femoral shaft
 - Distal femur
 - Tibial plateau
 - Tibial shaft
 - Distal tibia/pilon
 - Ankle
 - Calcaneus, talus
 - Lisfranc, Metatarsal
- For each location discussed, the resident will list the relevant radiographic classification scheme for the fracture.

Practice-Based Learning and Improvement

- By the end of the rotation, each PGY2 and PGY4 resident should be comfortable and confident with the following non-operative skills:
 1. Clinical assessment
 2. Upper Extremity Exam
 3. Lower Extremity Exam
 4. Evaluation and comprehension of x-rays for each fracture pattern
 5. An understanding of the psychosocial issues that are relative to trauma
 6. In addition, the PGY 4 resident should be comfortable with evaluation and comprehension of CT and MRI for each fracture pattern. The PGY4 resident should also be comfortable in the counseling of nonoperative management of various fracture patterns.
- Participate as an assistant in surgical procedures and as primary surgeon where level of skill makes this appropriate. Develop the planning and technical skills to the level that participation as primary surgeon is appropriate on most surgical cases.
- Demonstrate ability to effectively perform preoperative planning for surgical procedures, even complex cases.
- Set up an operating room for surgery, including surgical instruments, implants, patient positioning, need for fluoroscopy, etc.
- Understand and direct the role/limitations of Operating personnel: Scrubs, Nurses, Charge nurse, Company representatives, Schedulers, and Surgeons.

- Identify and clearly communicate the indication for every operation prior to scrubbing, to the attending and students as indicated.
- Know the algorithm for several techniques for each indication:
 - Be prepared in advance to complete the operation
 - Understand the choices for anesthesia and indications
 - Be ready to describe how to change course mid-operation, if needed
- Direct and perform the following procedures at the PGY2 level:
 1. safe positioning of the patient in surgery
 2. identification and initial management of postoperative complications
 3. approach and fixation of basic fracture patterns including hip, ankle, and long bone shaft, and distal radius.
 4. Placement of external fixation
- Direct and perform the following procedures at the PGY4 level (in addition to those listed above):
 5. analysis and management of postoperative complications
 6. approach and fixation of periarticular fractures
 7. approach to acetabulum and pelvic ring

Professionalism

- Learn to organize patient clinic practice while participating in more advance patient evaluation and management activities.
- Actively and competently participate in supervising the educational and clinical activities of the junior level residents (for PGY4s) or medical students (for PGY2s and 4s).
- Model appropriate professional values and behaviors for peers, faculty, and staff.
- Mature in the development of patient care, considering the cost, quality, outcomes, and impact on patient and healthcare system as essential variables in the equation.
- Demonstrate ability to engage in supportive, clear, and compassionate communication with patients and family members.
- Answer requests in a timely, cordial manner.

Interpersonal and Communication Skills

- The resident is expected on this rotation and all others to interact as a professional and team member with all the other staff and services within the hospital.
- The demeanor and tone of the resident in both verbal and nonverbal communication is expected to be exemplary.
- The same communication skills above are expected to be used with the patients and families.

Systems Based Practice

- Develop methods of analyzing complex data and prioritizing principles and issues to solve complex and ill-defined problems related to orthopaedic patient care.
- Demonstrate appropriate judgment, particularly as related to indications for surgical treatment of patients, non-operative treatment options and algorithms.
- Understand the daily business of Medicine/Orthopedic Surgery.

- Become facile with billing and coding issues.
- Manage the patient and health system to manage a disease/injury in the context of the biopsychosocial model.

Literature Resources:

Pelvic ring injury

Pennal GF, Tile M, Waddell JP, Garside H. Pelvic disruption: assessment and classification. Clin Orthop 1980;151:12-21

Tile M. Pelvic ring fractures: Should they be fixed? J Bone Joint Surg 1988;70B:1-12.

Burgess, AR, et al. Pelvic ring disruptions: Effective classification system and treatment protocols J. Trauma 1990;30:848-856.

Denis F, Davis S, Comfort T. Sacral fractures: an important problem. Retrospective analysis of 236 cases. Clin Orthop 1988;227:67-81.

Latenser BA, et al. Improved outcome with early fixation of skeletally unstable pelvic fractures. J Trauma 1991;31:28-31.

Roult ML Jr, Simonian PT, Ballmer F. A rational approach to pelvic trauma. Resuscitation and early definitive stabilization. Clin Orthop 1995;318:61-74.

Roult ML Jr, Kregor PJ, Simonian PT, Mayo K. Early results of percutaneous iliosacral screws placed with the patient in the supine position. J Orthop Trauma 1995;9:207-214.

Dujardin FH, et al. Long-term functional prognosis of posterior injuries in high-energy pelvic disruption. J Orthop Trauma 1998;12:145-151.

Acetabular fracture

Judet R, Judet J, Letournel E. Fractures of the acetabulum. Classification and surgical approaches for open reduction. J Bone Joint Surg 1964;46A:1616-1646.

Brumback RJ, et al. Acetabular depression fractures accompanying posterior fracture dislocation of the hip. J Orthop Trauma 1990;4:42-48.

Olson SA, Matta JM. The computerized tomography subchondral arc: a new method of assessing acetabular articular incongruity after fracture (a preliminary report). J Orthop Trauma 1993;7:402-413.

Letournel E. The treatment of acetabular fractures through the ilioinguinal approach. Clin Orthop 1993;292:62-76.

Matta JM. Fractures of the acetabulum: accuracy of reduction and clinical results in patients managed operatively within three weeks after the injury. J Bone Joint Surg 1996;78A:1632-1645.

Moed BR, Willson Carr SE, Watson JT. Results of operative treatment of fracture of the posterior wall of the acetabulum. J Bone Joint Surg 2002;84A:752-758.

Hip dislocation

Thomas VP, Epstein HC. Traumatic dislocation of the hip: A survey of two hundred and four cases covering a period of twenty-one years. J Bone Joint Surg 1951;33A:746-778.

Stuart JM, Milford LW. Fracture-dislocation of the hip: An end result study. J Bone Joint Surg 1954;36A:315-342.

Trueta J, Harrison MHM. The normal vascular anatomy of the femoral head in adult man. J Bone Joint Surg 1953;35B:442-461.

Yue JJ, Wilber JH, Lipuma JP, et al. Posterior hip dislocations: a cadaveric angiographic study. J Orthop Trauma 1996;10:447-454.

Femoral head fracture

Pipkin G. Treatment of grade IV fracture-dislocation of the hip: A review. J Bone Joint Surg 1957;39A:1027-1042.

Swiontkowski MF, Thorpe M, Seiler JG, et al. Operative management of displaced femoral head fractures: Case-matched comparison of anterior versus posterior approaches for Pipkin I and Pipkin II fractures. J Orthop Trauma 1992;6:437-442.

Hip fracture-low energy

Garden RS. Low-angle fixation in fractures of the femoral neck. J Bone Joint Surg 1961;43B:647-663.

Parker MJ, Khan RJK, Crawford J, et al. Hemiarthroplasty versus internal fixation for displaced intracapsular hip fractures in the elderly. J Bone Joint Surg 2002;84B:1150-1155.

Calder SJ, Anderson GH, Jagger C, et al. Unipolar or bipolar prosthesis for displaced intracapsular hip fractures in octogenarians: A randomized prospective study. *J Bone Joint Surg* 1996;78B:391-394.

Baumgaertner MR, Curtin SL, Lindskog DM. The value of the tip-apex distance in predicting failure of fixation of peritrochanteric fractures of the hip. *J Bone Joint Surg* 1995;77A:1058-1064.

Adams CJ, Robinson CM, Court-Brown CM, McQueen MM. Prospective randomized controlled trial of an intramedullary nail versus dynamic screw and side plate for intertrochanteric fractures of the femur. *J Orthop Trauma* 2001;15:394-400.

Aharonoff GB, Koval KJ, Skovron ML, et al. Hip fractures in the elderly: Predictors of one year mortality. *J Orthop Trauma* 1997;11:162-165.

Koval KJ, Skovron ML, Aharonoff GB, et al. Ambulatory ability after hip fracture: A prospective study in geriatric patients. *Clin Orthop* 1995;310:150-159.

Hip fracture-high energy

Swiontkowski MF, Winkquist RA, Hansen ST Jr. Fractures of the femoral neck in patients between the ages of twelve and forty-nine years. *J Bone Joint Surg* 1984;66A:837-846.

Jain R, Koo M, Kreder HJ, Schemitsch EH, Davey JR, Mahomed NN. Comparison of early and delayed fixation of subcapital hip fractures in patients sixty years of age or less. *J Bone Joint Surg* 2002;84A:1605-1612.

Femoral neck fracture biomechanics

Blair B, Koval KJ, Kummer F, et al. Basicervical fractures of the proximal femur. A biomechanical study of 3 fixation techniques. *Clin Orthop* 1994;306:256-263.

Stankewich CJ, Chapman J, Muthusamy R, et al. Relationship of mechanical factors to the strength of proximal femur fractures fixed with cancellous screws. *J Orthop Trauma* 1996;10:248-257.

Baitner AC, Maurer SG, Hickey DG, et al. Vertical shear fractures of the femoral neck. A biomechanical study. *Clin Orthop* 1999;367:300-305.

Femur fracture

Winqvist RA, Hansen ST Jr, Clawson DK. Closed intramedullary nailing of femoral fractures: A report of five hundred and twenty cases. *J Bone Joint Surg* 1984;66A:529-539.

Brumback RJ, Reilly JP, Poka A, et al. Intramedullary nailing of femoral shaft fractures: Part I. Decision-making errors with interlocking fixation. *J Bone Joint Surg* 1988;70A:1441-1452.

Brumback RJ, Uwagie-Ero S, Lakatos RP, et al. Intramedullary nailing of femoral shaft fractures; Part II. Fracture-healing with static interlocking fixation. *J Bone Joint Surg* 1988;70A:1453-1462.

Brumback RJ, Ellison TS, Poka A, et al. Intramedullary nailing of femoral shaft fractures: Part III. Long-term effects of static interlocking fixation. *J Bone Joint Surg* 1992;74A:106-112.

Brumback RJ, Ellison PS, Poka A, et al. Intramedullary nailing of open fractures of the femoral shaft. *J Bone Joint Surg* 1989;71A:1324-1331.

Bone LB, Johnson KD, Weigelt J, et al. Early versus delayed stabilization of femoral fractures: A prospective randomized study. *J Bone Joint Surg* 1989;71A:336-340.

Schwartz JT Jr, Brumback RJ, Lakatos R, et al. Acute compartment syndrome of the thigh: A spectrum of injury. *J Bone Joint Surg* 1989;71A:392-400.

Bone LB, Babikian G, Stegemann PM. Femoral canal reaming in the polytrauma patient with chest injury. A clinical perspective. *Clin Orthop* 1995;318:91-94.

Bosse MJ, MacKenzie EJ, Reimer BL, et al. Adult respiratory distress syndrome, pneumonia, and mortality following thoracic injury and a femoral fracture treated either with intramedullary nailing with reaming or a plate: A comparative study. *J Bone Joint Surg* 1997;79A:799-809.

Starr AJ, Hunt JL, Chason DP, et al. Treatment of femur fracture with associated head injury. *J Orthop Trauma* 1998;12:38-45.

Bhandari M, Guyatt GH, Khera V, et al. Operative management of lower extremity fractures in patients with head injuries. *CORR* 2003; 407:187-198.

Ostrum RF, Agarwal A, Lakatos R, et al. Prospective comparison of retrograde and antegrade femoral intramedullary nailing. *J Orthop Trauma* 2000;14:496-501.

Distal femur fracture

Bolhofner BR, Carmen B, Clifford P. The results of open reduction and internal fixation of distal femur fractures using a biologic (indirect) reduction technique. *J Orthop Trauma* 1996;10:372-377.

Krettek C, Schandelmaier P, Miclau T, et al. Minimally invasive percutaneous plate osteosynthesis (MIPPO) using the DCS in proximal and distal femoral fractures. *Injury* 1997;28 Suppl 1:A20-30.

Patella fracture

Smith ST, Cramer KE, Karges DE, et al. Early complications in the operative treatment of patellar fractures. *J Orthop Trauma* 1997;11:183-187.

Carpenter JE, Kasman RA, Patel N, Lee MA, Goldstein SA. Biomechanical evaluation of current patellar fracture fixation techniques. *J Orthop Trauma* 1997;11:351-356.

Knee dislocation

Green NE, Allen BL. Vascular injuries associated with dislocation of the knee. *J Bone Joint Surg* 1977;59A:236-241.

Johansen K, Lynch K, Paun M, Copass M. Noninvasive vascular tests reliably exclude occult arterial trauma in injured extremities. *J Trauma* 1991;31:515-522.

Mills WJ, Tejwani N. Knee dislocation, heterotopic ossification after knee dislocation: the predictive value of the injury severity score. *J Orthop Trauma* 17:338-345, 2004.

Tibial plateau fracture

Schatzker J, McBroom R, Bruce D. The tibial plateau fracture. The Toronto experience 1968-1975. *Clin Orthop* 1979;138:94-104.

Benirschke SK, Agnew SG, Mayo KA, et al. Immediate internal fixation of open, complex, tibial plateau fractures: treatment by a standard protocol. *J Orthop Trauma* 1992;6:78-86.

Barei DP, Nork SE, Mills WJ, Henley MB, Benirschke SK. Complications associated with internal fixation of high-energy bicondylar tibial plateau fractures utilizing a two-incision technique. *J Orthop Trauma* 2004;18:649-657.

Tibial shaft fracture

Sarmiento A, Sharpe FE, Ebramzadeh, et al. Factors influencing the outcome of closed tibial fractures treated with functional bracing. *Clin Orthop* 1995;315:8-24.

McQueen MM, Court-Brown CM. Compartment monitoring in tibial fractures. The pressure threshold for decompression. *J Bone Joint Surg* 1996;78B:99-104.

Littenberg B, Weinstein LP, Lebanon MM, et al. Closed fractures of the tibial shaft. A meta-analysis of three methods of treatment. *J Bone Joint Surg* 1998;80A:174-183.

Henley MB, Chapman JR, Agel J, et al. Treatment of type II, IIIA, and IIIB open fractures of the tibial shaft: a prospective comparison of unreamed interlocking intramedullary nails and half-pin external fixators. *J Orthop Trauma* 1998;12:1-7.

Ilizarov GA. The tension-stress effect on the genesis and growth of tissue: part I. The influence of stability of fixation and soft-tissue preservation. *Clin Orthop* 1989;238:249-262.

Ilizarov GA. The tension-stress effect on the genesis and growth of tissue: part II. The influence of the rate and frequency of distraction. *Clin Orthop* 1989;239:263-285.

Limb salvage

Lange RH, Bach AW, Hansen ST Jr. Open tibial fractures with associated vascular injury: prognosis for limb salvage. *J Trauma* 1985;25:203-208.

Johansen K, Daines M, Howey T, et al. Objective criteria accurately predict amputation following lower extremity trauma. *J Trauma* 1990;30:568-572.

Bosse MJ, MacKenzie EJ, Kellam JF, et al. A prospective evaluation of the clinical utility of lower-extremity injury-severity scores. *J Bone Joint Surg* 2001;83A:3-14.

Tibial plafond fracture

Ruedi T. Fractures of the lower end of the tibia into the ankle joint: results 9 years after open reduction and internal fixation. *Injury* 1973;5:130-137.

Teeny SM and Wiss DA. Open reduction and internal fixation of tibial plafond fractures. Variables contributing to poor results and complications. *Clin Orthop* 1993;292:108-117.

Wyrsh B, McFerran MA, McAndrew M, et al. Operative treatment of fractures of the tibial plafond. A randomized prospective study. *J Bone Joint Surg* 1996;78A:1646-1657.

Sirkin M, Sanders R, DiPasquale T, et al. A staged protocol for soft tissue management in the treatment of complex pilon fractures. *J Orthop Trauma* 1999;13:78-84.

Ankle fracture

Pettrone FA, Gail M, Pee D, et al. Quantitative criteria for the prediction of the results after displaced fracture of the ankle. *J Bone Joint Surg* 1983;65A:667-677.

Franklin JL, Johnson KD, Hansen ST Jr. Immediate internal fixation of open ankle fractures. Report of thirty-eight cases treated with a standard protocol. *J Bone Joint Surg* 1984;66A:1349-1356.

Phillips WA, Schwartz HS, Keller CS, et al. A prospective, randomized study of the management of severe ankle fractures. *J Bone Joint Surg* 1985;67A:67-78.

Thordarson DB, Motamed S, Hedman T, et al. The effect of fibular malreduction on contact pressures in an ankle fracture malunion model. *J Bone Joint Surg* 1997;79A:1809-1815.

Weening B, Bhandari M. Predictors of functional outcome following transsyndesmotric screw fixation of ankle fractures. *J Orthop Trauma* 2005;19:102-108.

Talus fracture

Hawkins LG. Fractures of the neck of the talus. *J Bone Joint Surg* 1970;52A:991-1002.

Canale ST, Kelly FB Jr. Fractures of the neck of the talus: Long-term evaluation of seventy-one cases. *J Bone Joint Surg* 1978;60A:143-156.

Lisfranc fracture

Kuo RS, Tejwani NC, DiGiovanni CW, et al. Outcome after open reduction and internal fixation of Lisfranc joint injuries. *J Bone Joint Surg* 2000;82A:1609-1618.

Richter, et al. Fractures and fracture-dislocations of the midfoot, occurrence, causes, long-term results. *Foot Ankle Int* 2001;22:392-398.

Calcaneus fracture

Essex-Lopresti P. The mechanism, reduction technique and results in fractures of the os calcis. (reprinted from *Br. J Surg* 1951) *Clin Orthop* 1993;290:3-16.

Sanders R, Fortin P, Dipasquale T, et al. Operative treatment in 120 displaced intraarticular calcaneal fractures: Results using a prognostic computed tomography scan classification. *Clin Orthop* 1993;290:87-95.

Harvey EJ, Grujic L, Early JS, Benirschke SK, Sangeorzan BJ. Morbidity associated with ORIF of intra-articular calcaneus fractures using a lateral approach. *Foot Ankle Int* 2001;22:868-873.

Buckley R, Tough S, McCormack R, Pate G, Leighton R, Petrie D, Galpin R. Operative compared with nonoperative treatment of displaced intra-articular calcaneal fractures. *J Bone Joint Surg* 2002;84A:1733-1744.

Shoulder injuries

Ada JR, Miller ME. Scapular fractures: Analysis of 113 cases. *Clin Orthop* 1991;269:174-180.

Nordqvist A, Petersson C, Redlund-Johnell I. The natural course of lateral clavicle fracture. 15 (11-21) year follow-up of 110 cases. *Acta Orthop Scand* 1993;64:87-91.

Robinson CM, Cairns DA. Primary nonoperative treatment of displaced lateral fractures of the clavicle. *J Bone Joint Surg* 2004;86A:778-782.

Bostman O, Manninen M, Pihlajamaki H. Complications of plate fixation in fresh displaced midclavicular fractures. *J Trauma* 1997;43:778-783.

Egol KA, Connor PM, Karunakar MA, et al. The floating shoulder: clinical and functional results. *J Bone Joint Surg* 2001;83A:1188-1194.

Proximal humerus fracture

Neer CS. Displaced proximal humerus fractures. Part I. Classification and evaluation. Part II. Treatment of three-part and four-part displacement. *J Bone Joint Surg* 1970;52A:1077-1103.

Mighell MA, Kolm GP, Collinge CA, Frankle MA. Outcomes of hemiarthroplasty for fractures of the proximal humerus. *J Shoulder Elbow Surg* 2003;12:569-577.

Koval KJ, Gallagher MA, Marsicano JG, et al. Functional outcome after minimally displaced fractures of the proximal part of the humerus. *J Bone Joint Surg* 1997;79A:203-207.

Humerus shaft fracture

Holstein A, Lewis GB. Fractures of the humerus with radial-nerve paralysis. *J Bone Joint Surg* 1963;45A:1382-1388.

Foster RJ, Swiontkowski MF, Bach AW, et al. Radial nerve palsy caused by open humeral shaft fractures. *J Hand Surg* 1993;18:121-124.

Ring D, Chin K, Jupiter JB. Radial nerve palsy associated with high-energy humeral shaft fractures. *J Hand Surgery* 2004;29A:144-147.

Sarmiento A, Zagorski JB, Zych GA, et al. Functional bracing for the treatment of fractures of the humeral diaphysis. *J Bone Joint Surg* 2000;82A:478-486.

Chapman JR, Henley MB, Agel J, et al. Randomized, prospective study of humeral shaft fracture fixation: intramedullary nails versus plates. *J Orthop Trauma* 2000;14:162-166.

Distal humerus fracture

Schemitsch EH, Tencer AF, Henley MB. Biomechanical evaluation of methods of internal fixation of the distal humerus. *J Orthop Trauma*. 1994;8:468-475.

Kundel K, Braun W, Wieberneit J, et al. Intraarticular distal humerus fractures, factors affecting functional outcome. *Clin Orthop* 1996;332:200-208.

McKee MD, Wilson TL, Winston L, et al. Functional outcome following surgical treatment of intraarticular distal humeral fractures through a posterior approach. *J Bone Joint Surg* 2000;82A:1701-1707.

Frankle MA, Herscovici D, DiPasquale TG, Vasey MB, Sanders RW. A comparison of open reduction and internal fixation and primary total elbow arthroplasty in the treatment of intraarticular distal humerus fractures in women older than age 65. *J Orthop Trauma* 2003;17:473-480.

Fractures and injuries about the elbow

Mason ML. Some observations on fractures of the head of the radius with a review of one hundred cases. *Br. J Surg* 1954:123-132.

Khalfayan EE, Culp RW, Alexander AH. Mason type II radial head fractures: operative versus nonoperative treatment. *J Orthop Trauma* 1992;6:283-289.

Hume MC, Wiss DA. Olecranon fractures. A clinical and radiographic comparison of tension band wiring and plate fixation. *Clin Orthop* 1992;285:229-235.

Bailey CS, MacDermid J, Patterson SD, King GJ. Outcome of plate fixation of olecranon fractures. *J Orthop Trauma* 2001;15:542-548.

Ring D, Jupiter JB, Sanders RW, et al. Transolecranon fracture-dislocation of the elbow. *J Orthop Trauma* 1997;11:545-550.

Forearm fractures

Anderson LD, Sisk DT, Tooms RE, Park WI. Compression plate fixation in acute diaphyseal fractures of the radius and ulna. *J Bone Joint Surg* 1975;57A:287-297.

Grace TG, Eversmann WW Jr. The management of segmental bone loss associated with forearm fractures. *J Bone Joint Surg* 1980;62A:1150-1155.

Moed BR, Kellam JF, Foster RJ, et al. Immediate internal fixation of open fractures of the diaphysis of the forearm. *J Bone Joint Surg* 1986;68A:1008-1017.

Schemitsch EH, Richards RR. The effect of malunion on functional outcomes after plate fixation of fractures of both bones of the forearm in adults. *J Bone Joint Surg* 1992;74A:1068-1078.

Wrist fractures

McQueen MM. Redisplaced unstable fractures of the distal radius. A randomised, prospective study of bridging versus non-bridging external fixation. *J Bone Joint Surg Br* 1999;80(4):665-669.

Wakefield AE, McQueen MM. The role of physiotherapy and clinical predictors of outcome after fracture of the distal radius. *J Bone Joint Surg Br* 2000;82(7):972-976.

Orbay JL, Fernandez DL. Volar fixed-angle plate fixation for unstable distal radius fractures in the elderly patient. *J Hand Surg [Am]* 2004;29(1):96-102.

Hildebrand KA, Ross DC, Patterson SD, Roth JH, MacDermid JC, King GJ. Dorsal perilunate dislocations and fracture-dislocations: questionnaire, clinical, and radiographic evaluation. *J Hand Surg [Am]* 2000;25(6):1069-1079.

Open fracture management

Gustilo RB, Anderson JT. Prevention of infection in the treatment of one thousand twenty-five open fractures of long bones: Retrospective and prospective analysis. *J Bone Joint Surg* 1976;58A:453-458.

Gustilo RB, Mendoza RM, Williams DN. Problems in the management of type III (severe) open fractures; A new classification of type III open fractures. *J Trauma* 1984;24:742-746.

Knapp TP, et al. Comparison of intravenous and oral antibiotic therapy in the treatment of fractures caused by low-velocity gunshots. A prospective, randomized study of infection rates. J Bone Joint Surg 1996;78A:1167-1171.

Fischer MD, Gustilo RB, Varecka TF. The timing of flap coverage, bone-grafting, and intramedullary nailing in patients who have a fracture of the tibial shaft with extensive soft tissue injury. J Bone Joint Surg 1991;73A:1316-1322.