

## Journal Scan

### Journal of Orthopaedic Trauma

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Published online: 30 July 2008  
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#### General

**Detection of orthopaedic implants by airport metal detectors.** Obremskey WT, Austin T, Crosby C, Driver R, Kurtz W, Shuler F, Kregor P. *J Orthop Trauma*. 2007;21:129–132.

Context: After the September 11, 2001 terrorist attacks, the Federal Aviation Administration (FAA) increased sensitivity of airport metal detectors. This study examines the effect of patients' body mass index (BMI), implant type, size, location, number, and material on detection by certified Transportation Security Administration (TSA) and FAA airport metal detectors set to today's standard sensitivity.

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**Study Design and Results:** This retrospective study involved 96 regularly scheduled trauma clinic patients with a wide variety of orthopaedic implants. Patients walked through an airport arch metal detector and also were examined with a handheld metal detector (wand). Detection of implants by arch detector or wand was recorded. Other information gathered included BMI, location of implants, type, metal composition, and size. All joint prostheses (9/9) were detected. Subjects with four or fewer screws and no other implants were never detected by the arch metal detector (0/7). Overall, 43 of the patients had a positive response produced. In addition, free-standing (ex vivo) devices were examined by the detectors.

**Conclusions:** Most, but not all orthopaedic devices were detected. Prostheses, plates with a length greater than 10 holes, and titanium nails were most likely to be detected. Body mass index was not shown to affect detectability of orthopaedic implants.

**Comments:** Some implants when tested ex vivo were detected even though the metal detectors were not activated by the same implant in vivo. Thus, there is some variability in the process. All patients should be counseled that orthopaedic devices may set off alarms, so to speak.

**Pearls:** Perhaps patients should be given a card identifying their implant, and possibly including a picture of the radiograph to obviate the need for a detailed body search.

**Pre-injury status: are orthopaedic trauma patients different than the general population?** Gabbe BJ, Cameron PA, Graves SE, Williamson OD, Edwards ER, on behalf of the Victorian Orthopaedic Trauma Outcomes Registry (VOTOR) Project Group. *J Orthop Trauma*. 2007;21:223–228.

**Context:** Establishing the preinjury health status and health-related quality of life (HRQL) of trauma patients is important for measuring the quality of recovery after injury, but remains inherently difficult owing to inability to collect this information prospectively.

**Study Design and Results:** Data from 2388 orthopaedic trauma patients were captured by the Victorian Orthopaedic Trauma Outcomes Registry (VOTOR) between October 2003 and January 2006. The preinjury SF-12 scores were obtained for 1839 patients and compared with population norms. The trauma patients had higher (better) SF-12 scores than the population norm, were predominantly men, and were 18 to 54 years old. The mean mental SF-12 scores for the trauma patients were better than those for the general population, particularly women.

**Conclusions:** Establishing the preinjury HRQL of trauma patients is important for evaluating the quality of patient outcomes. Where individual preinjury data cannot be collected, population norms could be used as a reasonable estimate of preinjury status to assess quality of recovery.

**Comments:** Obtaining an assessment of preinjury status after an injury occurs creates the potential for recall bias. However, having baseline SF-12 scores before a traumatic injury is not a reasonable or realistic alternative.

**Pearls:** Data regarding the preinjury health status and health-related quality of life of trauma patients provides a unique perspective on the socioeconomic profile typically attributed to this patient population.

## Pelvis

**Early predictors of mortality in hemodynamically unstable pelvis fractures.** Smith W, Williams A, Agudelo J, Shannon M, Morgan S, Stahel P, Moore E. *J Orthop Trauma*. 2007;21:31–37.

**Context:** Unstable pelvic fractures can be life-threatening injuries with mortality rates ranging from 5% to 50%. The relationship of mortality with respect to age, fracture class, trauma scores, need for pelvic angiography, and blood requirements has not been established.

**Study Design and Results:** One hundred eighty-seven consecutive patients with pelvic fractures and hemodynamic instability (persistent systolic blood pressure, 90 mm Hg after receiving 2 L of intravenous crystalloid) were reviewed retrospectively. Patients underwent a standardized pelvis fracture protocol. Data collected included the Injury Severity Score (ISS), Revised Trauma Score (RTS), age, blood transfusion requirements, presence of multisystem organ failure (MOF), and outcome (mortality). Thirty-nine patients did not survive their injury. Fracture pattern and the need for embolization were not predictive of death. The ISS, RTS, age older than 60 years, and

transfusion were statistically significant independent predictors of mortality.

**Conclusions:** Revised Trauma Score was the most predictive independent variable for death after pelvic fracture. Death within 24 hours was most often a result of acute blood loss whereas death after 24 hours most often was caused by MOF. Improved survival depends on evolution of early hemorrhage control and resuscitative strategies in patients at high mortality risk.

**Comments:** Predictors of mortality in patients with pelvis fractures should be available early during the treatment course to be useful. A model including ISS, RTS, age, and transfusion volume was superior at predicting mortality. Most deaths were attributed to exsanguination (74.4%) or MOF (17.9%).

**Pearls:** Patients who are hemodynamically unstable after a pelvic ring injury should undergo emergent treatment including intravenous fluids or blood to address hemodynamic instability, acute warming for hypothermia, and a circumferential sheet or commercial binder for temporary reduction of pelvic volume. Angiography can address arterial bleeding in the pelvis, but does little to address venous exsanguination.

**Do initial radiographs agree with crash site mechanism of injury in pelvic ring disruptions? A pilot study.** Linnau KF, Blackmore CC, Kaufman R, Nguyen TN-H, Routt ML Jr, Stambaugh LE 3rd, Jurkovich GJ, Mock CN. *J Orthop Trauma*. 2007;21:375–380.

**Context:** The direction of injury forces, inferred from radiographs may be used to identify associated injuries and guide intervention. For example, the pattern of a fibular fracture may articulate the presence of a ligament injury that does not appear on the radiograph per se. Whether such an analysis is reasonable in pelvic fractures is not known.

**Study Design and Results:** The objective of this study was to compare injury direction determined from anteroposterior (AP) pelvic radiographs with injury forces obtained from crash-site investigations. Twenty-eight subjects from the Crash Injury Research Engineering Network database who met inclusion criteria of pelvic ring disruption, single-event crash, restrained front-seat occupant, diagnostic-quality pelvic radiography, and complete crash investigation data were retrospectively reviewed. Crash-site investigation data included principal direction of force, crash magnitude, and passenger compartment intrusion. An orthopaedic trauma surgeon and a fellowship-trained emergency radiologist independently assessed the pelvic radiographs to determine the injury direction of force and the Young-Burgess and Tile fracture classifications, with disputes resolved by an additional emergency radiologist. The direction of force was anterior in nine

(32%) and lateral in 19 (68%) subjects. The readers agreed with the crash primary direction of force in 21 (75%) subjects. In subjects with a lateral direction of force, agreement was 89% (17/19) compared with 44% for anterior (4/9). Interobserver agreement for the Young and Tile classification schemes was moderate.

**Conclusions:** Crash-site investigation and pelvic radiography may provide conflicting information about primary direction of injuring forces. Presumed anterior impact based on primary direction of force is not in consistent agreement with the pattern of injury evident on the AP pelvic radiograph.

**Comments:** This study showed that there often are clashes between the forces of injury suggested by the crash investigation versus that suggested by the radiograph. Crash-site investigation data are rarely available in the trauma bay, and thus inferences from the radiographs may be reasonable. Still, orthopaedic surgeons should recall that these inferences may be faulty.

**Pearls:** Defining the gold standard is a not uncommon problem in orthopaedic research. For instance, do we say the MRI overcalled the meniscal tear or that the surgeon missed it? Likewise, it is not clear whether the crash investigation or the radiograph analysis is the true gold standard.

## Lower Extremity

**Primary repair of knee dislocations: results in 25 patients (28 knees) at a mean follow-up of four years.** Owens BD, Neault M, Benson E, Busconi BD. *J Orthop Trauma*. 2007;21:92–98.

**Context:** The treatment of knee dislocations is controversial: one option would be to repair the ligaments and the second is to immobilize the leg and perform a late reconstruction if needed. Although surgical repair offers superior stability compared with nonoperative management (and therefore, may save some patients from reconstructive procedures), it has been associated with stiffness. The purpose of this study was to evaluate primary surgical repair of knee dislocations followed by a consistent, modern rehabilitation program.

**Study Design and Results:** This retrospective study consisted of 25 consecutive patients with knee dislocations between 1994 and 2002 who had primary repair of all injured ligaments by one surgeon. The patients also had an early rehabilitation protocol. The mean followup was 48 months. The mean postoperative Lysholm score was 89.0 and all knees were clinically stable. The mean loss of extension was 2°, the mean loss of flexion was 10°, and the mean arc of motion was 120°.

**Conclusions:** Primary repair of ligaments coupled with an early rehabilitation program provides comparable

outcomes to those of published series of ligament reconstruction—with the obvious benefit of sparing the patient a prolonged period of recovery. Primary repair of ligaments in the dislocated knee should be considered an effective option in the trauma population. Arthrofibrosis continued to be problematic with five of the 28 knees needing lysis of adhesions and manipulation at an average of 16 weeks (range, 8–36 weeks).

**Comments:** This was not a head-to-head study (ie, the controls were historical) and thus does not prove anything regarding superiority of one method over another. However, it does provide ample justification, in our mind, for primary repair as an option to be offered.

**Pearls:** Peroneal nerve injury has been reported in approximately 25% of knee dislocations and in 41% of knees with an injury to the posterolateral ligament complex. Some degree of peroneal nerve injury was present in 21 knees (75%) in the current study. All patients with peroneal nerve injury also had a concomitant posterolateral ligamentous injury. It may be worthwhile to consider these patients in a second category when contemplating management: if you are going to explore the nerve, you might have a lower threshold to perform a repair.

**Operative treatment of 109 tibial plateau fractures: five- to 27-year follow-up results.** Rademakers MV, Kerkhoffs GMMJ, Sierveelt IN, Raaymakers ELFB, Marti RK. *J Orthop Trauma*. 2007;21:5–10.

**Context:** A consensus has not yet been established for ideal management of tibial plateau fractures. Additionally, long-term outcome after various treatment protocols is not yet clear, despite the voluminous discussion of different treatment protocols in the literature. Recent studies assessing only surgically treated patients by means of ORIF show good results but have relatively small patient groups and short-term followup. The aim of this study was to evaluate the functional and radiologic long-term results of surgically treated tibial plateau fractures.

**Study Design and Results:** This retrospective study evaluated 202 consecutive operatively fixed tibial plateau fractures at 1 year. One hundred nine of these fractures were reevaluated at a minimum of 5 years with functional and radiographic measures. At 1 year, the union rate was 95% and the average ROM was 130°. At a mean of 14 years, ROM was 135° and the average HSS knee score was 85. Thirty-one percent of patients had secondary osteoarthritis develop. Malalignment greater than 5° in patients led to significantly more arthritis compared with patients with an anatomic axis.

**Conclusions:** Long-term results after open reduction and internal fixation for tibial plateau fractures are excellent, independent of the patient's age.

Comments: Ten of the 202 patients originally included were not analyzed in the long-term group as those 10 patients had secondary salvage procedures (four arthrodeses, four correction osteotomies, two total knee arthroplasties). Functional scores of the injured knee 1 year after surgery adequately predict future knee function for years to come. Also, this was not a trial showing superiority of operative management, as there may be a selection bias regarding which patients were indicated for surgery.

Pearls: The primary goals of operative fixation of tibial plateau fractures are obtaining near perfect articular reduction along with restoring the mechanical axis of the lower extremity to prevent arthrosis and the need for joint replacement. If arthroplasty is apt to be needed soon because of prefracture arthrosis (possibly predicted by radiographs of the contralateral side), conservation of the bone stock and maintenance of the soft tissue envelope is paramount.

**Biomechanical analysis of bicondylar tibial plateau fixation: how does lateral locking plate fixation compare to dual plate fixation?** Higgins TF, Klatt J, Bachus KN. *J Orthop Trauma*. 2007;21:301–306.

Context: Open reduction and internal fixation has been the standard of care for most displaced intraarticular tibial plateau fractures, but this has been a particularly troublesome procedure in bicondylar fractures. When both condyles are involved, buttressing or fixation of the medial and the lateral cortices with dual plates has been indicated to prevent medial collapse and subsequent varus deformity. The biologic implications of medial and lateral soft tissue stripping are concerning, and this has been associated with a high complication rate. Locked plates have made it possible to achieve fixation of some displaced bicondylar injuries without directly plating the medial side. The purpose of this study was to compare the stability of locked lateral plating and dual plating in complex bicondylar tibial plateau fractures.

Study Design and Results: Ten matched pairs of human cadaveric proximal tibia specimens were cyclically loaded. Subsidence of the medial and lateral condyles was measured following 10,000 cycles from 100 N to 1000 N. The maximum load to failure on the medial condyle for both plate constructs also was measured. On the lateral side, dual plating resulted in an average of 0.7 mm subsidence, compared with 1.0 mm for the fixed-angle plate ( $p = 0.077$ ). On the medial side, dual plating allowed an average of 0.8 mm subsidence, compared with 1.5 mm for the locked lateral plate ( $p = 0.045$ ). No significant difference was found in the maximal load to medial condyle fixation failure between either plating construct.

Conclusions: Dual plate fixation allows for less subsidence in a cadaveric bicondylar tibial plateau fracture model when compared with only locked lateral plating.

Comments: With a deep infection rate greater than 8% reported with a dual-incision technique in experienced hands, there is certainly an incentive to try to fix the entire bicondylar injury from the lateral side only. However, this study may raise concerns about the widespread use of isolated lateral locked plate constructs in bicondylar tibial plateau fractures.

Pearls: If isolated lateral locked plating does not provide sufficient fixation to resist subsidence of the medial condyle, axial alignment of the limb may be lost, producing varus deformity and jeopardizing the long-term outcome. However, complications from extensive surgery also can jeopardize the long-term outcome.

**The effect of concurrent fibular fracture on the fixation of distal tibia fractures: a laboratory comparison of intramedullary nails with locked plates.** Straus EJ, Alfonso D, Kummer FJ, Egol KA, Tejwani NC. *J Orthop Trauma*. 2007;21:172–177.

Context: Fractures of the distal tibial metaphysis typically occur as a result of axial and rotational forces on the lower extremity. Although different treatment methods have been developed for distal tibia fractures including intramedullary fixation or plate fixation, there is currently no consensus on the optimal mode of management. This study was performed to compare the mechanical properties and fixation stability of intramedullary nails versus locked plates. Additionally, the impact of a concomitant, same-level fibula fracture on the fixation stability of each treatment option was evaluated.

Study Design and Results: A simulated, distal metaphyseal tibia fracture was created in eight pairs of cadaveric tibia-fibula specimens. One of each pair was treated using an intramedullary nail and the other with a locked plate. Axial, bending, and cyclical loads were applied to each specimen. Load-displacement curves and fracture displacement were measured. A fibular osteotomy then was created in each specimen at the same level as the tibia fracture, torsional stiffness assessment and cyclic vertical loading were repeated, and fracture displacement measurements were again obtained. The locked plate construct was stiffer in axial loading. The intramedullary nail construct was stiffer in cantilever bending. After creation of the fibular osteotomy fracture, construct displacements significantly increased and torsional stiffness significantly decreased. The locked plate constructs had significantly less displacement after cyclic loading than the locked nail constructs. Locked plate constructs were stiffer in torsion after osteotomy than the intramedullary nail constructs.

Conclusions: This study showed that, in the treatment of distal metaphyseal tibia fractures, locked plates provided more stable fixation than intramedullary nails in vertical

loading but were less effective in cantilever bending. An intact fibula in the presence of a distal tibia fracture improved fracture fixation stability for both treatment methods.

**Comments:** In fracture patterns in which the fibula cannot be stabilized effectively, locked plates offer improved mechanical stability when compared with locked intramedullary nails. However, if the fibula can be stabilized a nail may be adequate.

**Pearls:** Fibular fixation in distal metaphyseal tibia fractures has several advantages. Fixation of the fibula can provide adequate assessment of length, alignment, and rotation of the limb. Furthermore, fibular fixation has been shown to decrease the risk of loss of reduction after intramedullary fixation of distal tibial fractures.

## Upper Extremity

**The importance of medial support in locked plating of proximal humerus fractures.** Gardner MJ, Weil Y, Barker JU, Kelly BT, MD, Helfet DL, Lorich DG. *J Orthop Trauma*. 2007;21:185–191.

**Context:** When locking plates are placed on the lateral proximal humerus, the mechanical environment is such that the fixed angle screws are required to act as perpendicular struts to support the humeral head fragment and resist varus displacement. These forces may be exaggerated when there is lack of medial column support, and the ability of these screws to perform this function is unknown. The purpose of this study was to evaluate the radiographic behavior of

proximal humerus fractures treated acutely with locking plates with particular attention to medial column support.

**Study Design and Results:** This is a retrospective review of 35 patients who underwent locked plating for a proximal humerus fracture and were followed until healing. Medial support was considered to be present if the medial cortex was anatomically reduced, if the proximal fragment was impacted laterally in the distal shaft fragment, or if an oblique locking screw was positioned inferomedially in the proximal humeral head fragment. Multivariate linear regressions were performed to determine the effects that age, gender, fracture type, cement augmentation, and medial support had on loss of reduction. The presence of medial support had a significant effect on loss of reduction by greater than 4 mm. Age, gender, fracture type, or cement augmentation had no effect on maintenance of reduction.

**Conclusions:** Achieving mechanical support of the inferomedial region of the proximal humerus seems to be important for maintaining fracture reduction.

**Comments:** Locked plates in general do not appear to be a panacea for proximal humerus fractures as they are unable to support the humeral head alone from a lateral tension-band position.

**Pearls:** There are several factors in the surgeon's control that may improve the mechanical environment. Achieving an anatomic or slightly impacted stable reduction and meticulously placing a superiorly directed oblique locked screw in the inferomedial region of the proximal fragment may achieve more stable medial column support and allow for better maintenance of reduction.