

## SPECIALTY UPDATE

## What's New in Orthopaedic Trauma

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The field of musculoskeletal trauma continues to benefit from advances in basic science, improved methods of treatment (both operative and nonoperative), innovation in surgical devices, and more sophisticated research methodology, with emphasis on comparative clinical trials and appropriate assessment of outcomes. The emphasis on evidence-based management continues in the literature and in presentations at academic conferences.

For this year's summary of advances in orthopaedic traumatology, the authors again reviewed all issues of *Acta Orthopaedica*, *Clinical Orthopaedics and Related Research*, *Injury*, *The Journal of Bone and Joint Surgery* (both American and British volumes), *Journal of Orthopaedic Trauma*, *Journal of Shoulder and Elbow Surgery*, and *The Journal of Trauma*. Selected articles from other journals were also included. Finally, presentations from the annual meetings of the Orthopaedic Trauma Association (OTA) and the American Academy of Orthopaedic Surgeons (AAOS) were reviewed. Articles and presentations that represent Level-I and Level-II evidence are reviewed in this article along with other articles of clinical importance in the opinion of the authors.

### Outcomes

The rigorous documentation of outcome, especially from the patient's perspective, has been one of the major advances in orthopaedic surgery over the past decade. Two studies investigated differences between patient and surgeon perceptions of outcome after orthopaedic trauma. One study evaluated patients six months after they had sustained a "major" fracture<sup>1</sup>. Surgeons were more satisfied with their patients' progress than the patients themselves were. The only factor associated with surgeon satisfaction was fracture-healing. Objective injury and treatment factors were not associated with patient satisfaction in terms of progress. Attributing blame of the injury to others was associated with patient satisfaction in terms of

progress, whereas blame, the use of a lawyer, and female sex were associated with patient satisfaction in terms of recovery<sup>1</sup>.

The Lower Extremity Assessment Project (LEAP) investigators reported data, obtained from their observational study of patients with limb-threatening lower extremity injury, that documented the discrepancy between patient and surgeon perceptions of functional and cosmetic outcomes<sup>2</sup>. Several factors were predictive of discordance; some were associated with higher surgeon satisfaction whereas others were associated with greater patient satisfaction. Self-reported patient dissatisfaction with overall medical care was predictive of discordance in the perception of both overall and cosmetic outcomes between patients and surgeons.

A third study assessed the outcomes of "after-hours" treatment of tibial and femoral shaft fractures with intramedullary nailing<sup>3</sup>. Patients undergoing femoral or tibial nailing at night had a higher rate of unplanned reoperation than those managed during the day, and patients with femoral fractures that were treated at night had a greater need for interlocking screw removal in comparison with those who were managed during the day (27% compared with 3%). The authors concluded that allocating resources to increase daytime surgery for non-emergency intramedullary nailing cases has the potential to decrease the rate of minor complications.

### Polytrauma

The concepts and proper application of damage-control orthopaedics continue to be defined. In one series of polytrauma patients undergoing treatment of femoral fractures, "normalizing lactate" was considered to be indicative of adequate resuscitation and the indication to proceed with primary intramedullary nailing of the fracture<sup>4</sup>. Overall, 88% of patients underwent femoral nailing with reaming at an average of fourteen hours after admission, whereas 12% underwent provisional external fixation. Adult respiratory distress syndrome occurred in 1.5% of patients, which was lower than the rate among historic controls. Adult respiratory distress syndrome was also less common than expected in patients with

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pulmonary injury and in the most severely injured patients. These findings indicate that simple measures of resuscitation (in this case, serum lactate) are reasonable indicators of when a patient is physiologically able to undergo nailing for the treatment of a femoral fracture.

Another study challenged the idea that external fixation is the only effective method of provisional femoral fracture stabilization when employing damage-control orthopaedics<sup>5</sup>. There was no difference in terms of adult respiratory distress syndrome, multisystem organ failure, and pneumonia in poly-trauma patients undergoing delayed stabilization of a femoral fracture that had been treated initially with skeletal traction or placement of an external fixator. There also were no differences when patients with associated chest trauma were compared. The authors concluded that, unless a patient is already undergoing general anesthesia, there is no significant advantage of external fixation as compared with skeletal traction.

### Open Fractures, Wound Management, and Infection

A continued source of controversy in orthopaedic trauma is whether increased time to surgical debridement increases the infection rate in patients with open fractures. The LEAP investigators evaluated their cohort of patients with severe lower extremity trauma and found that the time from injury to debridement was not predictive of infection<sup>6</sup>. However, the time from the injury to admission to the definitive treatment center was a significant predictor of infection. Because of the observational nature of this study, the reasons for this finding are not clear, and the authors concluded that their data "should not be interpreted as an argument that operative debridement of open fractures should not be accomplished urgently."

Vacuum-assisted wound closure (also referred to as negative-pressure wound therapy) is now commonly used for the initial treatment of open fracture wounds, despite the fact that there are few data regarding the efficacy of this approach. Stannard et al. randomized sixty-two severe open fractures to treatment with negative-pressure wound therapy or sterile moist saline solution dressings until ultimate closure or coverage<sup>7</sup>. Overall, 5.4% of patients managed with negative-pressure wound therapy developed an infection, compared with 28% of patients in the control group, a finding that was statistically significant and clinically important. Patients managed with negative-pressure wound therapy also had improved outcomes as measured with the Short Form-36 (SF-36).

Diabetes is a recognized risk factor for complications following fracture surgery. Karunakar and Staples recently presented the effects of stress-induced hyperglycemia on the rates of infection in 110 nondiabetic orthopaedic trauma patients<sup>8</sup>. Overall, 25% of the patients developed an infection, including pneumonia (seventeen patients) and wound infection (eleven patients). Sixty-four percent of patients with a hyperglycemic index of  $\geq 3.0$  developed an infection, compared with 21% of patients with a hyperglycemic index of  $< 3.0$ , indicating that stress-induced hyperglycemia may be an im-

portant prognostic factor. Additional work is needed to understand whether the correction of elevated blood sugar in nondiabetic patients reduces the risk of infection.

Infection must be considered in cases of fracture non-union. In one series of nonunions, a diagnostic protocol including preoperative laboratory tests (white blood-cell count, erythrocyte sedimentation rate, C-reactive protein level), white blood cell/sulfur colloid scans, and intraoperative frozen sections was followed<sup>9</sup>. Overall, 31.6% of patients were diagnosed with infection. The white blood cell/sulfur colloid scan was found to have a sensitivity of only 19%. The positive predictive value for infection increased with the addition of each positive laboratory value (white blood-cell count, erythrocyte sedimentation rate, C-reactive protein level). When all three values were positive, the positive predictive value for infection was 100%. On the basis of their data, the authors recommended preoperative laboratory studies and intraoperative frozen-section analysis for the diagnosis of infection in this high-risk population.

### Venous Thromboembolism

Thromboembolic disease is a major source of morbidity in patients with musculoskeletal injury and continues to be the focus of research. Very little data exist regarding the treatment of venous thromboembolism in patients with isolated leg injuries. Goel et al. performed a double-blind randomized trial in which a low-molecular-weight heparin (Dalteparin; Pfizer, New York, NY) was compared with placebo (saline solution injection) in 238 adult patients undergoing operative repair of a fracture distal to the knee<sup>10</sup>. After fourteen days of treatment, the rate of venographic deep-vein thrombosis was 12.6% in the placebo group, compared with 8.7% in the treatment group; this difference was not significant. All thromboses were distal to the knee, and none required treatment. However, the study was underpowered, and the absolute risk difference of 3.9% would equate to a number-needed-to-treat of twenty-six, which might be clinically relevant. Increased age and the type of fracture also were found to increase the risk of deep-vein thrombosis. There were no bleeding complications in the low-molecular-weight heparin group. A substantial limitation of that study is the fact that the end point of venographically proven but asymptomatic deep-vein thrombosis is also of uncertain clinical relevance, and the patients in the study were all operatively managed within forty-eight hours after the injury. The negative results of that study may not be generalizable to patients who have a longer delay to surgery. Larger studies of the treatment of venous thromboembolism in trauma patients are needed before conclusions can be made.

### Geriatric Fractures

Geriatric patients with fractures present a number of management issues, including the prevention of delirium. A randomized controlled trial demonstrated that, in elderly hip fracture patients managed with propofol, light sedation

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(bispectral index, >80) was associated with a dramatic reduction in the incidence of delirium as compared with deep sedation (bispectral index, <50)<sup>11</sup>. Patients in the deep sedation group also experienced delirium for a longer time than did those in the light sedation group.

Two studies addressed the use of iron supplementation for the treatment of postoperative anemia after the fixation of hip fractures. In the first study, patients were randomized to either 200 mg of ferrous sulfate twice daily for four weeks or no therapy<sup>12</sup>. The authors found no significant difference in hemoglobin levels or change in hemoglobin levels at six weeks and found no differences in terms of the length of hospital stay or mortality. Seventeen percent of patients reported minor side effects attributable to iron therapy. In contrast, a smaller randomized trial demonstrated some benefit in association with the use of iron therapy for the correction of postoperative anemia after the fixation of a hip fracture. Patients were randomized to receive 200 mg of ferrous sulfate three times daily for four weeks or no therapy. At four weeks postoperatively, the treated patients had a small but significant increase in hemoglobin levels and a lower reported prevalence of side effects<sup>13</sup>. Larger trials are needed to definitively establish whether oral iron-replacement therapy is efficacious for correcting postoperative anemia in geriatric patients with a hip fracture.

Many geriatric fractures are related to osteoporosis, but a study of a large insurance database in Korea suggested that the likelihood of further evaluation and treatment of osteoporosis is dependent on the type of fragility fracture that a patient sustains<sup>14</sup>. The authors analyzed >150,000 fractures in female patients who were more than fifty years old. The overall rate of diagnosis and subsequent treatment of osteoporosis was 19.3%. However, patients with wrist fractures were less likely to be evaluated and managed for osteoporosis as compared with the overall cohort. The authors believed that a “care gap” exists and suggested that further efforts and initiatives should be directed toward improving the evaluation and subsequent treatment of osteoporosis that may be manifested early by a fracture of the wrist.

### Pediatric Fractures

Two recent studies presented different views of the controversial issue of the “pulseless hand” associated with pediatric supracondylar humeral fractures. Choi et al. analyzed 1255 consecutive children who had operative treatment of a supracondylar humeral fracture<sup>15</sup>. In this large group, only thirty-three patients (2.6%) presented with absent distal pulses; twenty-four of them had a pink, perfused hand. None of the twenty-four children with absent distal pulses but a well-perfused hand required vascular intervention. Of these twenty-four patients, thirteen regained a palpable pulse after fracture reduction and the other eleven maintained adequate distal perfusion. Nine other children presented with absent pulses and a poorly perfused hand. Four of these nine patients required vascular intervention, and two developed compartment

syndrome. Thirty-two of the thirty-three patients were available for follow-up at a median of eight weeks, and all were noted to have satisfactory perfusion. The second study, by Blakey et al., evaluated the longer-term follow-up for twenty-six children who had been referred to their institution with a history of a “pink pulseless hand” associated with a supracondylar humeral fracture<sup>16</sup>, which is a different patient population than was reported by Choi et al.<sup>15</sup>. The range of time between the injury and referral was broad (four days to three years). Twenty-three (88%) of the twenty-six patients developed some degree of ischemic contracture. The authors advocated an aggressive approach toward children with a “pink pulseless hand” in order to avoid such complications<sup>16</sup>. On the surface, these two studies seem contradictory. However, one had short-term follow-up, whereas the other had much longer follow-up, and, most importantly, the two study populations were very different. Additional research is needed to clearly identify whether there is a subset of patients with a “pink pulseless hand” who are at greater risk of long-term morbidity and should potentially be managed with urgent vascular exploration.

Several studies evaluated aspects of pediatric femoral fractures. Basener et al. performed a meta-analysis of sixteen articles (564 children) documenting that growth disturbance after distal femoral physeal fractures is common<sup>17</sup> (see the Evidence-Based Orthopaedics section at the end of this article). Keeler et al. presented a series of eighty pediatric femoral fractures in patients with a mean age of 12.9 years who were managed with reaming and statically locked antegrade nailing with use of a lateral trochanteric entry portal<sup>18</sup>. All fractures healed without evidence of malunion, and no patient had evidence of osteonecrosis or of altered proximal femoral anatomy. The authors concluded that antegrade femoral nailing via a lateral trochanteric portal is safe and effective for children who are more than eight years old. However, the starting point that those authors used was very lateral and fairly distal on the trochanter, increasing risk of deformity.

### Proximal Part of the Humerus

Fractures of the proximal part of the humerus continue to be a source of debate, and a particular problem is predicting outcome. A recent study evaluated the ability of the initial shoulder radiographs to predict the outcome of nonoperative treatment of proximal humeral fractures<sup>19</sup>. In a study of fifty-five patients with minimally displaced proximal humeral fractures, the authors found a correlation between worse outcome scores (Constant-Murley and Disabilities of the Arm, Shoulder and Hand [DASH] scores) and changes in angulation during the first week after the injury on the trans-scapular “Y” radiograph but not on the anteroposterior radiograph. Patients with the poorest scores had a mean change in angulation of 30° on the scapular “Y” radiograph, compared with no change for those with the best outcome scores. Although change in angulation is just one of many items to consider, this

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change can be measured objectively and does appear to be predictive of outcome. Surgeons should take special care to assess changes in angulation on the lateral radiographs.

Locked plating has become commonplace for the treatment of proximal humeral fractures. A number of larger case series were recently published regarding the outcome of locked plating, although comparative studies are still lacking<sup>20-22</sup>. Taken together, all of these studies emphasize that final outcomes are not achieved for at least one year and that complications occur in one-third of patients, with screw penetration (either at the time of surgery or later), varus collapse, and osteonecrosis being most common<sup>20-22</sup>. Complications are more frequent in patients who are more than sixty years old and in those with more complex fracture patterns<sup>20</sup>. In general, varus malunion is associated with poor functional outcomes<sup>20</sup>.

### Elbow

Traditional fixation of intra-articular distal humeral fractures has relied on fixation with two plates oriented at 90° to one another. Recently, anatomic precontoured plates designed to be placed parallel to each other on the medial and lateral surfaces of the distal part of the humerus have been made available. A comparison of these two methods in a small randomized clinical trial showed no differences in terms of the ranges of elbow flexion and extension, the Mayo Elbow Performance Score, time to union, or complications<sup>23</sup>. Both methods seem to provide adequate stability, and either method can be used to achieve stable and anatomic reconstruction of the distal part of the humerus.

Complex elbow injuries remain an area of active research. A recent study focused on Mason type-II injuries of the radial head, in which part of the radial head is displaced >2 mm<sup>24</sup>. The injuries were grouped according to whether or not there was cortical contact between the fractured fragment and the rest of the radius. Overall, 75% of the cases did not have cortical contact, and, of these, 91% were part of a complex elbow fracture pattern with associated fractures and/or ligamentous injury. In contrast, just 33% of the fractures with cortical contact were considered to be part of a complex injury. Therefore, complete loss of cortical contact in radial head fractures should alert the clinician that the radial head fracture may be just one part of a complex injury pattern and that additional evaluation and expert management are needed.

Three groups of investigators reported the results of long-term studies of elbow injuries involving the radial head<sup>25-27</sup>. In one study, good to excellent elbow function was seen in thirteen of sixteen patients who had had internal fixation of a stable Mason type-II radial head fracture between fourteen and thirty years earlier (mean duration of follow-up, twenty-two years)<sup>25</sup>. However, as the authors themselves pointed out, these long-term results of surgery for the treatment of stable, isolated partial articular radial head fractures were not better than the reported results of nonoperative treatment, and there were major complications of surgery in this series. Another

study evaluated the results of radial head resection following a Mason type-II or III radial head fracture; the duration of follow-up ranged from fifteen to thirty-nine years<sup>26</sup>. No patient had complications or a reoperation, and the clinical result was graded as good or excellent in 92% of cases. The average carrying angle of the elbow was twice that of the contralateral elbow (21° compared with 10°), and a minor amount of radial shortening (average, 3.1 mm) was a typical finding. Radial head resection in young patients with isolated radial head fractures without instability can yield satisfactory long-term results. In the final study, twenty-one patients with a Mason type-IV fracture-dislocation, without a type-II or III coronoid process fracture, were evaluated after a mean duration of follow-up of twenty-one years (range, fourteen to forty-six years)<sup>27</sup>. All patients underwent closed reduction and had the elbow immobilized for two to six weeks. Eleven patients underwent complete radial head excision, two had partial radial head excision, and two others had an annular ligament repair. At the time of long-term follow-up, only one patient had severe impairment of the elbow, and no patient experienced instability or recurrent dislocation. The authors concluded that most patients who have a Mason type-IV fracture-dislocation of the elbow, without an associated coronoid fracture, have a good long-term outcome.

### Distal Part of the Radius

There is wide variation in the rate of distal radial fracture depending on demographic group, with the highest rates in whites and females<sup>28</sup>. There is also wide geographic variation in incidence. According to Medicare data, operative intervention for distal radial fractures in the elderly has increased fivefold in the last decade, although nonoperative treatment remains most common<sup>29</sup>. Treatment modality varies widely across regions within the United States but is not affected by race.

Many options exist for the treatment of distal radial fractures, without much evidence to choose among them. Several studies during the past year compared treatment methods and provided further guidance for surgeons who treat these injuries. In one randomized study of fifty patients, fragment-specific fixation provided better results at the time of the one-year follow-up than did closed reduction and external fixation in terms of grip strength, motion, and the rate of malunion<sup>30</sup>. However, there were no differences in terms of the DASH score at one year. In another study of patients with unstable fractures, early results as measured with DASH scores were better after volar plating than after closed reduction and pinning<sup>31</sup>. However, at the time of the one-year follow-up, the differences between groups had disappeared. A third randomized study compared three methods of treatment: external fixation, radial column plating, and volar plating<sup>32</sup>. In addition to DASH scores, grip and lateral pinch strength were measured. Treatment with a volar plate was associated with improved early outcomes, but there were no differences between groups at later follow-up periods (six months and one

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year). A final study used decision analysis methodology to show that volar plating was the preferred strategy in most scenarios, but the magnitude of differences was small<sup>33</sup>. In general, the long-term gains in quality-adjusted life-years outweighed the risk of surgical complications. Older patients who might tolerate a malunion may be better managed nonoperatively.

### Spine Trauma

A topic of consistent debate is “clearance” of the spine in a patient with blunt trauma. A meta-analysis of the published literature concluded that an alert, asymptomatic patient without another distracting injury and no neurologic deficit can be cleared without radiographic assessment if he or she can complete a functional neck range-of-motion examination without pain or the elicitation of neurologic signs and symptoms<sup>34</sup>.

Two Level-I diagnostic studies assessed screening tests for spine injury. In the first, the diagnostic accuracy of magnetic resonance imaging findings (as determined by a radiologist) for detecting injury to the posterior ligament complex of the cervical spine was evaluated, with use of intraoperative findings as the diagnostic standard<sup>35</sup>. The level of agreement between magnetic resonance imaging and intraoperative findings varied between fair (for injury to the ligamentum flavum, facet capsules, and cervical fascia) to moderate (for injury to the supraspinous and interspinous ligaments). In general, magnetic resonance imaging was found to be sensitive for the evaluation of injury, but the positive predictive value and specificity were lower because of “over-reading” of injuries on magnetic resonance imaging. Using magnetic resonance imaging findings alone as a guide to treatment could lead to unnecessary surgery, and other factors should be part of the decision-making process. Another study tested the reliability of nonreconstructed computed tomography of the abdomen and pelvis as a screening tool for thoracolumbar spine injuries in blunt trauma patients with altered mental status<sup>36</sup>. Such patients were studied with a protocol that included standard anteroposterior and lateral radiographs of the thoracolumbar spine in addition to standard 5-mm computed tomography slices of the chest, abdomen, and pelvis and  $\leq 2$ -mm reconstructed slices dedicated to the spine. Compared with the dedicated computed tomography reconstructions, nonreconstructed 5-mm computed tomography slices had a sensitivity of 89% and specificity of 85% for the detection of all fractures, which was much greater than those of radiographs (37% and 76%, respectively). None of the fractures that were missed on nonreconstructed computed tomography examination required surgery or other intervention, and the authors concluded that computed tomography reconstructions do not need to be routinely performed in this setting unless further clarification is needed for an abnormality that has already been detected.

A randomized clinical trial of seventy-three patients with thoracolumbar burst fractures undergoing posterior short-segment fixation with or without fusion demonstrated no

differences in terms of clinical or radiographic outcomes, although two-thirds of the fusion patients had donor-site pain from the bone graft at the time of the latest follow-up<sup>37</sup>.

### Pelvic and Acetabular Fractures

The effect of pelvic fracture on patient mortality was analyzed in a review of >63,000 patients from two level-I trauma centers<sup>38</sup>. Pelvic fracture was significantly associated with mortality, with odds ratios for mortality of 2.4 and 2.0 at the two centers. These odds ratios were equivalent to the mortality odds ratio associated with an abdominal injury but were less than the odds ratios associated with hemodynamic shock, severe head injury, and advanced age. When analyzed in combination with the other aforementioned risk factors for mortality, pelvic fracture was independently associated with mortality with the exception of a patient in hemodynamic shock with a severe head injury. While pelvic fracture is associated with mortality, it is only one factor to be considered in the overall care of the polytraumatized patient<sup>38</sup>.

Two highlight papers from the OTA annual meeting reviewed the treatment of lateral compression injuries of the pelvis. Sembler et al. presented a series of 120 patients with unilateral lateral compression fractures of the sacrum that were impacted and minimally displaced (<10 mm)<sup>39</sup>. All patients were immediately mobilized, were allowed weight-bearing as tolerated, and were followed radiographically until healing had occurred. Only one patient had a failure of nonoperative treatment, with 5 mm of additional sacral displacement associated with severe pain. The remaining 119 patients had uneventful healing with minimal further displacement. Nonoperative treatment, including early weight-bearing, is appropriate for impacted unilateral lateral compression-type sacral fractures<sup>39</sup>. Another presentation reviewed 117 patients from two level-I trauma centers who had sacral fractures resulting from high-energy trauma<sup>40</sup>. These sacral fractures were part of a lateral compression pelvic ring injury and were initially displaced <5 mm. Patients were also managed nonoperatively with weight-bearing as determined by the treating physician. In contrast to the first series, twenty-three of 117 fractures had further displacement (>5 mm) at the time of healing. It was noted that a complete sacral fracture, typified by a visible fracture line in the posterior cortex of the sacrum, was associated with displacement 50% of the time. A complete sacral fracture combined with bilateral superior and inferior rami fractures was associated with displacement 68% of the time. An incomplete sacral fracture with no rami fractures or unilateral ramus fracture did not displace. The results of these studies highlight the importance of careful analysis of the fracture pattern and patient characteristics prior to allowing immediate weight-bearing after lateral compression sacral fractures. Further research is needed to define functionally relevant residual sacral displacement to determine what role operative treatment has, if any, in certain lateral compression sacral fractures.

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The treatment of the geriatric acetabular fracture is controversial. In one surgeon's experience, the proportion of these fractures occurring in patients more than sixty years of age increased 2.4 times when the period from 1980 to 1993 (10% of cases) was compared with the period from 1993 to 2007 (24% of cases)<sup>41</sup>. Involvement of the anterior column is more frequent among older patients, who are also more likely to have separate quadrilateral plate fragments, roof impaction in association with anterior fractures, and both comminution and marginal impaction in association with posterior fractures<sup>41</sup>. These factors make internal fixation of acetabular fractures more problematic in the elderly. A review of patients with an age of more than sixty-five years who underwent treatment of acetabular fractures demonstrated a one-year mortality of 25%<sup>42</sup>. Of the surviving patients, 85% had been managed operatively, most with formal open reduction and internal fixation. Twenty-eight percent of the living patients had undergone eventual total hip replacement at an average of 2.5 years later. The patients who had open reduction and internal fixation had Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and SF-8 scores similar to population norms, although many had reported mild functional problems and some level of hip pain. A third study examined the results of a retrospective case series of patients (average age, seventy-two years) who were managed with combined open reduction and internal fixation and primary total hip arthroplasty<sup>43</sup>. Among the eighteen patients with at least one year of follow-up, there was only one acetabular failure requiring revision surgery, three weeks after the index procedure. At the time of the latest follow-up, the mean Harris hip score was 88 and radiographs showed minimal medial and vertical displacement of the cup, with no evidence of acetabular loosening. In appropriate patients, surgeons who are experienced in both techniques of internal fixation of the pelvis and arthroplasty can safely perform combined open reduction and internal fixation and total hip arthroplasty with minimal complications and can potentially avoid the need for a second procedure.

### Fractures of the Proximal Part of the Femur

Fractures of the proximal part of the femur impose an extremely large societal burden, and many studies have been presented or published in the past year that contribute to our overall understanding of the care of these complicated injuries. A recent meta-analysis in the *Annals of Internal Medicine* examined the mortality after hip fracture in >700,000 patients<sup>44</sup>. The relative risk of death from all causes in the first three months after hip fracture was 5.75 for women and 7.95 for men. The relative risk of death decreased dramatically over the first two years but continued to be elevated compared with age and sex-matched controls at ten years. Men continued to have a higher relative risk of mortality over time compared with women. A retrospective study of 97,894 patients in the Nationwide Inpatient Sample analyzed the effect of surgeon and

hospital volume on morbidity and mortality after hip fracture<sup>45</sup>. The adjusted odds ratio for mortality for a low-volume surgeon (fewer than seven procedures per year) relative to a high-volume surgeon (more than fifteen procedures per year) was 1.24. A significant difference in mortality between low and high-volume hospitals was not found. Differences in morbidity were found between low and high-volume surgeons, with increased rates of pneumonia, decubitus ulceration, and transfusion requirements associated with low-volume surgeons. Similarly, increased rates of pneumonia, postoperative infection, and transfusion requirements were associated with low-volume hospitals.

The treatment of proximal femoral fractures, especially those of the femoral neck, remains a source of controversy, especially with regard to the role of primary arthroplasty. Recently, the ten-year follow-up results of a previously reported randomized trial comparing arthroplasty with internal fixation for the treatment of displaced femoral neck fractures were published<sup>46</sup>. Overall, 45.6% of the surviving patients who were managed with internal fixation had a failure of fracture treatment, but only four of ninety-two failures occurred between two and ten years. In comparison, 8.8% of the patients who were managed with arthroplasty had a failure of treatment, and five of seven failures occurred between two and ten years. These late failures in the arthroplasty group were in patients who had undergone total hip arthroplasty. Only 5.2% of the initial patients who were managed with arthroplasty experienced recurrent dislocation, with relatively equal numbers occurring after total hip arthroplasty and hemiarthroplasty. The mortality rate was the same for the arthroplasty and internal fixation groups at ten years, and no significant differences were noted between the groups with regard to hip pain when walking or with regard to reduced mobility secondary to hip symptoms.

Gjertsen et al. reviewed 4335 elderly patients from the Norwegian Hip Fracture Register who had a displaced femoral neck fracture and who had been managed with internal fixation or bipolar hemiarthroplasty and followed for a minimum of one year<sup>47</sup>. Mortality at one year was not significantly different between the internal fixation and hemiarthroplasty groups (27% compared with 25%). The reoperation rate was 22.6% for patients managed with internal fixation, compared with 2.9% for patients managed with hemiarthroplasty. Patients who had undergone hemiarthroplasty had better functional outcomes at one year as measured on the EQ-5D index score. These data further support hemiarthroplasty as being superior to internal fixation for the treatment of displaced femoral neck fractures in this patient population.

Two recent randomized trials compared hemiarthroplasty with or without cement for the treatment of femoral neck fracture. The first study randomized 400 patients to treatment with either a cemented (Thompson) or uncemented (Austin-Moore) stem<sup>48</sup>. Overall, patients who had a hemiarthroplasty with cement had less pain on the visual

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analog scale at eight weeks and a lower Charnley pain score at three, six, twelve, and twenty-four months. Patients who had a hemiarthroplasty with cement also did not experience as great a loss of mobility in comparison with patients who had undergone a hemiarthroplasty without cement. The second study, which included 223 patients, demonstrated very different results in association with the use of a more modern uncemented stem with a hydroxyapatite coating (Corail; DePuy)<sup>49</sup>. The Harris hip score was not found to be different between the group with the uncemented stem and the group with the cemented stem (SPECTRON; Smith & Nephew) at three and twelve months of follow-up. There also were no differences in terms of functional outcomes as measured with the EQ-5D index score at three and twelve months. The uncemented Austin-Moore stem should have little use in modern hip hemiarthroplasty, with its main application being as a "quick" endoprosthesis in a patient with minimal functional demands but in need of pain control. A study of hemiarthroplasty after hip fracture did not demonstrate significant differences in terms of blood loss, transfusion requirements, or seventy-two-hour postoperative hemoglobin levels between standard and minimally invasive approaches<sup>50</sup>. Better functional results were documented at two years postoperatively in patients managed with a standard approach.

Extracapsular fractures also have been a source of controversy, primarily related to the expanding role of cephalomedullary nails instead of sliding hip screws. Proponents of nailing techniques highlight the minimally invasive nature and improved biomechanical characteristics of nails. Proponents of sliding hip screws point out their familiar technique and their lower cost. A meta-analysis compared several minimally invasive approaches (intramedullary nailing, percutaneous plating, minimally invasive sliding hip screw placement, and external fixation) to traditional insertion of a sliding hip screw<sup>51</sup>. No significant differences were found between groups in terms of the rates of fixation failure or mortality. Although the relative risk of blood transfusion was lower in the combined minimally invasive group, the relative risk of blood transfusion associated with intramedullary nailing alone (four studies) was not significantly different from that associated with the standard sliding hip screw. A small randomized controlled trial comparing sliding hip screw placement via a minimally invasive technique (length of incision, 2.5 cm) with a standard incision (length of incision, 10 to 15 cm) was recently published<sup>52</sup>. Patients in the minimally invasive group had decreased blood loss and a decreased transfusion rate, with less pain and improved physical functioning on the third postoperative day. No differences were seen in terms of radiographic outcomes or functional scores at three months.

A meta-analysis of Gamma nails compared with compression hip screws emphasized the decreasing rates of femoral fracture that have occurred with time, likely because of improvements in patient selection, surgical techniques, and the implants themselves<sup>53</sup>.

**Other Femoral Fractures**

Cannada et al. reported on a large series of high-energy femoral neck-shaft fractures<sup>54</sup>. In that study of 2897 patients with a femoral shaft fracture, the overall prevalence of associated femoral neck fracture was 3.2%; 88% of patients had injuries to another body system and 75% had other orthopaedic injuries. One-fourth of the femoral neck fractures were not identified preoperatively. Missed injuries occurred in 18% of the patients who had thin-cut computed tomography scans. Nonunion or malunion occurred in association with 12.1% of femoral neck fractures, and half of these cases were in patients who were diagnosed late. A high degree of vigilance is required to diagnose a femoral neck fracture, and even thin-cut computed tomography is not sufficient to make the diagnosis by itself in every case<sup>54</sup>.

In another study involving 1126 femoral shaft fractures that were treated with intramedullary nailing, forty-six patients with femoral nonunions (4% of the total number of cases) were compared with a matched control group of ninety-two patients with healed femoral fractures<sup>55</sup>. Open fracture and tobacco use were found to be predictive of nonunion. Interestingly, 72% of patients who developed nonunions of femoral fractures had delayed weight-bearing as a consequence of other injuries. On the basis of the results of this study, the authors reported that they have become more aggressive with early weight-bearing whenever possible after intramedullary nailing of femoral shaft fractures.

Controversy still exists among surgeons with regard to the relative benefits of antegrade versus retrograde nailing of the femur. A recent randomized study evaluated knee function after antegrade and retrograde femoral nailing<sup>56</sup>. No differences in knee flexion (132° and 134° in the antegrade and retrograde groups, respectively), Lysholm scores, or isokinetic muscle performance were noted between the groups. Older patients also tended to have lower Lysholm scores and decreased knee flexion compared with younger patients, irrespective of treatment.

Unlike femoral shaft fractures, there has been little controversy regarding distal femoral fractures, for which locking plates seem to have been widely adopted. Ricci et al. analyzed the risk factors associated with failure of locked plating for the treatment of distal femoral fractures in a study of 305 patients<sup>57</sup>. Overall, 9% of patients developed a nonunion, whereas another 6% required a planned staged bone-grafting procedure. A history of diabetes mellitus was the only independent predictor of nonunion. Implant failures occurred in 8% of cases; 60% of failures occurred in the proximal fragment. Independent predictors of implant failure included diabetes, an OTA A3 fracture pattern, body mass index, a stainless steel plate, and a shorter plate length. Proximal implant failure was less likely when plate length was ten holes or longer, when eight holes or more covered the proximal diaphyseal fragment, when more proximal screws were utilized, and when the screw density (percentage of screw holes filled) was <60% in the

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proximal portion of the plate<sup>57</sup>. These data provide useful guidelines for surgeons using locked plates in the distal part of the femur.

### Tibia and Tibial Plateau

Several recent studies evaluated compartment syndrome associated with tibial fractures. Park et al. reviewed all of the tibial fractures that were treated over a thirty-four-month period at a single level-I trauma center<sup>58</sup>. The authors determined the rate of compartment syndrome on the basis of anatomic location. Tibial shaft fractures were associated with the highest rate of compartment syndrome (8.1%), followed by proximal tibial fractures (1.6%). "Decreasing age" was the only factor that was found to independently predict compartment syndrome. However, others have reported much higher rates of compartment syndrome in association with proximal tibial fractures<sup>59</sup>. Stark et al. retrospectively reviewed sixty-seven bicondylar tibial plateau fractures and seventeen medial condylar fracture-dislocations that were all treated with initial application of a spanning external fixator within the first forty-eight hours<sup>59</sup>. The overall rate of compartment syndrome was 27%: the rate was 53% (nine of seventeen) in patients with medial condylar fracture-dislocations and 18% (nine of fifty) in patients with bicondylar tibial plateau fractures. Of the nine patients with medial condylar fracture-dislocations who developed compartment syndrome, six (67%) developed compartment syndrome after the application of an external fixator. Another study highlighted the apparent variation in the diagnosis of compartment syndrome in patients with tibial fractures<sup>60</sup>. Among 386 tibial shaft fractures that were treated by seven orthopaedic surgeons with similar training, compartment syndrome was diagnosed in 10.4% of the cases. However, the rate of diagnosis of compartment syndrome varied widely by surgeon, ranging from 2% to 24%. This variation in diagnosis also may help to explain the large differences in the rate of compartment syndrome found throughout the literature. The authors also found that male sex was an independent predictor of compartment syndrome.

A new assessment tool for the evaluation of tibial fracture-healing was recently introduced<sup>61</sup>. The Radiographic Union Score for Tibial Fractures (RUST) is a scoring system that is based on radiographs and is designed to standardize the assessment of tibial fracture-healing. The scoring is based on the presence or absence of a fracture line as well as the presence or absence of callus and, if present, whether the callus is bridging. Each of the four cortices is assessed independently, and a total score is then calculated on the basis of the sum of the scores for each cortex. Intraobserver and interobserver reliability were found to be "substantial" (intraclass correlation coefficient, 0.88 and 0.86, respectively). Pending further evaluation, the RUST score may ultimately help to standardize clinical treatment as well as orthopaedic research.

A recent retrospective study compared the efficacy of intramedullary nailing and percutaneous locked plating for the

treatment of extra-articular proximal tibial fractures<sup>62</sup>. The two groups were slightly different, with a greater proportion of open fractures in the nailing group than in the plating group (55% compared with 35%). There was a trend ( $p = 0.10$ ) toward higher union rate after the index procedure in the plating group as compared with the nailing group (94% compared with 77%). Although this difference would be of clinical importance if true, the difference in union rates could not be "proved" because of the small number of patients. Interestingly, all closed fractures in both groups healed after the index procedure. Apex anterior malalignment of  $>5^\circ$  was found after 36% of the nailing procedures, although additional fracture-reduction techniques (such as blocking screws) were commonly utilized, indicating that malreduction continues to be a complication of nailing of proximal tibial fractures. In contrast, apex anterior malalignment was present after 15% of the plating procedures. There was a higher rate of symptomatic implant removal in the plating group than in the nailing group (15% compared with 5%), but this difference also did not reach significance because of the small number of patients. Although the authors concluded, on the basis of their data, that no overwhelming advantage exists for either nailing or plating for the treatment of extra-articular proximal tibial fractures, they did highlight a number of potentially important clinical differences that require validation in prospective trials that are under way.

### Ankle

The Lauge-Hansen classification represents the standard nomenclature describing ankle fractures and has been the subject of much recent work attempting to determine whether its mechanistic descriptions actually produce the expected injuries. In one study, twenty-three fresh-frozen cadavers were tested with the foot in a position of pronation<sup>63</sup>. One group had a pure external rotation force applied, whereas the other group had a combined external rotation-abduction force applied. Short oblique fractures of the distal part of the fibula, typically described as supination-external rotation injuries, were seen in both groups. The classic pronation-external rotation fracture, a proximal fibular fracture occurring after a medial-sided injury, occurred only after the addition of an abduction force. The authors concluded that fractures that are typically described as supination-external rotation injuries could be produced with the foot in the pronated position and that the abduction moment may be an important factor in determining the fracture pattern<sup>63</sup>. A study presented at the 2009 OTA Annual Meeting utilized video clips of ankle injuries publicly available on the Internet (youtube.com) to analyze the accuracy of the Lauge-Hansen classification system for predicting the actual mechanism of injury<sup>64</sup>. The authors determined the position of the foot and the deforming force from the injury video and compared the documented mechanism of injury with the resultant radiographic fracture pattern. While video clips judged to show supination-adduction injuries corre-



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sponded to supination-adduction radiographic patterns 100% of the time (five of five), video clips judged to show pronation-external rotation corresponded to the classic pronation-external rotation radiographic pattern only 50% of the time (three of six).

In recent years, the posterior malleolus has received more attention. One study assessed the reliability of radiographs to adequately evaluate trimalleolar ankle fractures<sup>65</sup>. Twenty-two patients with trimalleolar ankle fractures were reviewed by eight experienced orthopaedic traumatologists. Intraobserver reproducibility, interobserver reliability, and accuracy were considered to be “good” only when considering the size of the posterolateral fragment. Other characteristics of the fracture, including extension of the fracture line into the posteromedial corner of the plafond, the presence of loose osteochondral fragments, and the presence of impaction, failed to display reproducibility and reliability and also lacked accuracy when compared with the computed tomography scan. The authors advocated routine preoperative computed tomography scanning for all trimalleolar ankle fractures, although no data were presented to indicate that the routine use of computed tomography would improve outcomes.

Two studies addressed the short and long-term outcomes of ankle fractures. A study of 57,183 patients who were managed in California outlined the complication rates associated with the surgical treatment of ankle fractures<sup>66</sup>. Short-term complications, defined as readmission within ninety days after surgery, were highest for patients with complicated diabetes and peripheral vascular disease. Patients with complicated diabetes had an increased risk of wound infections (7.71%) and revision open reduction and internal fixation (4.43%) in the first ninety days. The same study also demonstrated that patients with a trimalleolar ankle fracture had an odds ratio of 2.07 for requiring an ankle fusion or replacement within five years as compared with patients with isolated lateral malleolar fractures. Hospital volume did not appear to be predictive of short or long-term complications. A Swiss study compared long-term outcomes after operative treatment of supination-external rotation type-IV ankle fractures with a medial malleolar fracture and supination-external rotation type-IV ankle fractures with an intact medial malleolus and a partially or completely torn deltoid ligament<sup>67</sup>. After a mean duration of follow-up of thirteen years, patients with a supination-external rotation type-IV ankle fracture with a partially or completely torn deltoid ligament did better functionally than those with a medial malleolar fracture.

The treatment of ankle syndesmosis injuries continues to be a source of debate, and several studies on this topic were presented or published in the past year. A retrospective study of 347 ankle fractures revealed that patients who required syndesmotomic fixation had worse outcomes on the Short Musculoskeletal Function Assessment (SMFA) Dysfunction Index and American Orthopaedic Foot and Ankle Society (AOFAS) score at both six months and one year as compared with pa-

tients with ankle fractures not requiring syndesmotomic stabilization<sup>68</sup>. A study presented at the 2009 OTA meeting analyzed the functional consequences of syndesmotomic malreduction<sup>69</sup>. Sixty-eight patients who had undergone syndesmotomic stabilization more than two years previously underwent clinical assessment and bilateral computed tomography of the ankle. Overall, 39.1% of syndesmotomic injuries were found to be malreduced. The patients with malreduced syndesmotomic injuries scored significantly lower on both the SMFA and Olerud and Molander questionnaires. On the basis of these data, the authors recommended direct visualization of the syndesmosis, although they offered no evidence that such an approach would have a different outcome. In another study, the syndesmosis was directly visualized and reduced in all cases, although stabilization was performed in several ways (open reduction and internal fixation of a posterior malleolar fragment, locking syndesmotomic screw fixation, or combination of the two)<sup>70</sup>. The authors compared their radiographic results with those for a historic control group of patients from the same institution who had had fluoroscopic assessment of reduction and found significant radiographic improvement (malreduction rate, 16% compared with 52%)<sup>70</sup>.

Much debate continues about the management of screws that are used to stabilize the syndesmosis. Miller et al. reported the necessity of removing locked syndesmotomic screws in a series of twenty-five patients who had undergone stabilization of a syndesmotomic injury with two locking quadricortical screws through a locking third tubular plate<sup>71</sup>. The syndesmotomic implant was routinely removed at four months, and patients experienced immediate improvement in the objective range of motion and improvement in functional scores<sup>71</sup>. Two other studies, involving the use of traditional cortical screws, did not support the routine removal of all syndesmotomic screws. In a retrospective review, patients with a “broken” syndesmotomic screw had higher AOFAS scores than patients with an “intact” syndesmotomic screw after a mean duration of follow-up of thirty months<sup>72</sup>. In that study, 3.5-mm screws were used, but the number of screws and the number of cortices purchased varied, and loose screws were included in the “intact” syndesmotomic screw group. In another retrospective study, the outcomes for patients with loose screws or broken screws were compared with those for patients whose screws were intact and patients whose screws had been removed<sup>73</sup>. A variety of screw configurations were used, which limits the interpretation of the results. In general, functional scores were lower for patients who had intact screws as compared with those who had loose or broken screws or who had undergone screw removal. The authors concluded that while their data did not support the routine removal of loose or broken screws, there may be a role for the removal of intact syndesmotomic screws. Finally, a follow-up study of a previously reported randomized clinical trial comparing quadricortical with tricortical syndesmotomic fixation was published<sup>74</sup>. Forty-eight of the original sixty-four patients were evaluated after an average duration of follow-up of 8.4

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years. The patients had syndesmosis stabilization with either a single 4.5-mm quadricortical screw or two 3.5-mm tricortical screws. At the time of follow-up, no differences were detected in functional scores between the two groups. Interestingly, patients who had a difference in syndesmotic width of  $\geq 1.5$  mm (signifying a malreduction or loss of initial reduction) on computed tomography as compared with the contralateral ankle tended to have worse functional outcomes on the modified AOFAS score ( $p = 0.056$ ). Interpretation of these studies is difficult as different screw sizes, numbers, and modes of fixation were used.

A recent systematic review of nine Level-I or II studies addressed the effect of early mobilization on the outcome of operative treatment of ankle fractures<sup>75</sup>. There was significantly greater range of motion at the time of early follow-up (nine and twelve weeks) in the early-motion group. However, this difference in range of motion was not significant at one year. Patients in the early-motion group returned to work earlier, and there also was a trend ( $p = 0.12$ ) toward decreased rates of deep vein thrombosis in the early-motion group. Patients in the early-motion group did have a higher rate of infection than those who were managed with immobilization<sup>75</sup>.

Recently reported data suggest that the location and depth of intra-articular lesions associated with ankle fractures predict functional outcomes<sup>76</sup>. Patients who underwent operative treatment of an ankle fracture had intra-articular pathology assessed intraoperatively via arthroscopy, and the long-term outcome for a subset of patients was documented at a mean of 12.9 years. Overall, 81% of patients had cartilage injury noted during arthroscopy, with the most common site being the talus. The odds ratio of having any cartilage injury and an AOFAS score of  $<90$  was 5.0. The depth of the lesion and the location of the lesion were found to be significant predictors of later osteoarthritis. The odds ratio of having a deep lesion located on the anterior aspect of the talus and an AOFAS score of  $<90$  was 12.3. The authors did not find a correlation between the number of lesions and a worse functional outcome.

### Foot

Several studies regarding the treatment of calcaneal fractures were reported or presented during the past year. Potter and Nunley presented the long-term functional outcomes for a large cohort of patients with operatively treated calcaneal fractures who were evaluated at a median of 12.8 years<sup>77</sup>. Eighteen percent of patients reported having had a subsequent operation, with the most common reason being pain at the site of surgery due to the implant. Only two patients (3%) had gone on to subtalar arthrodesis. The mean adjusted AOFAS score was 65.4, and no differences were noted when patients were stratified on the basis of Workers' Compensation status. A difference was noted in two of the three functional scores when patients were stratified on the basis of the mechanism of injury. Patients who sustained a calcaneal fracture secondary to

a fall had higher functional outcome scores than did patients who sustained a fracture secondary to a motor-vehicle accident.

A randomized trial was conducted to evaluate the effectiveness of calcium phosphate bone-void filler for the treatment of displaced intra-articular calcaneal fractures<sup>78</sup>. Open reduction and internal fixation plus an injectable calcium phosphate was compared with open reduction and internal fixation alone. While the Bohler angle decreased over time in both treatment groups, the decrease was significantly greater in the open reduction and internal fixation alone group at six months and one year of follow-up. While the group that had been managed with open reduction and internal fixation plus calcium phosphate maintained the immediate postoperative Bohler angle to a greater extent than did the group that had been managed with open reduction and internal fixation alone, this maintenance did not translate into improved functional outcomes. No differences were detected between the two groups in terms of the SF-36 or the Lower Extremity Measure (LEM) at six months and one year. No differences were detected between the two groups in terms of the pain scale at two years.

Two studies evaluated subtalar arthrodesis following a calcaneal fracture. One study highlighted the impact of the initial treatment of calcaneal fractures on subsequent subtalar fusion<sup>79</sup>. Patients who were initially managed nonoperatively required distraction subtalar arthrodesis tailored to the type of malunion that was present. Patients who were initially managed with open reduction and internal fixation were able to be managed with in situ subtalar arthrodesis. The two groups were compared after a mean duration of follow-up of more than sixty months. Patients who initially underwent open reduction and internal fixation had a significantly lower rate of infection and had significantly better functional outcomes (Maryland Foot Score and the AOFAS ankle-hindfoot score). Last, the intermediate-to-long-term results of primary subtalar fusion for nonreconstructible intra-articular calcaneal fractures were reported<sup>80</sup>. Over a seventeen-year period, thirty-five such fractures (all of which were classified as Sanders type-III or IV) were treated with combination open reduction and internal fixation/primary subtalar fusion. Fifteen patients were available for follow-up at a mean of 9.8 years. The mean AOFAS ankle-hindfoot score at the time of follow-up was 79.8. Talocalcaneal height was found to be associated with functional outcome scores.

### Evidence-Based Orthopaedics

The editorial staff of *The Journal* reviewed a large number of recently published research studies related to the musculoskeletal system that received a Level of Evidence grade of I or II. Over 100 medical journals were reviewed to identify these articles, all of which have high-quality study design. A list of twelve Level-I and II articles that were relevant to orthopaedic trauma is appended to this review following the standard bibliography. We have provided a brief commentary about each

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of the articles to help guide your further reading, in an evidence-based fashion, in this subspecialty area.

### Upcoming Educational Events Featuring Orthopaedic Trauma

The annual meeting of the Orthopaedic Trauma Association is held every October. Please see the OTA web site ([www.ota.org](http://www.ota.org)) for information regarding the courses in 2010 and 2011. A Comprehensive Fracture Course for Residents is held in conjunction with the fall meeting every year. In addition, the OTA meets at Specialty Day during the AAOS annual meeting and plans an educational event suitable for any surgeon who wants to learn more about trauma care. Finally, an OTA Trauma Fellows

Course is held in the spring and is scheduled for April 15 to 17, 2011. The AAOS and OTA cosponsor annual courses on extremity trauma in the fall and spring; please see the OTA web site for further details about courses in 2010 and 2011.

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**Evidence-Based Articles Related to Orthopaedic Trauma**

**Basener CJ, Mehlman CT, DiPasquale TG.** Growth disturbance after distal femoral growth plate fractures in children: a meta-analysis. *J Orthop Trauma.* 2009;23:663-7.

The authors performed a meta-analysis of sixteen articles that included a total of 564 physal fractures of the distal part of the femur. The rate of growth disturbance was 52%. Twenty-two percent of children developed a leg-length discrepancy of >1.5 cm. Growth disturbance occurred most frequently in children with Salter-Harris type-IV fractures (64%), followed by Salter-Harris type-II fractures (58%). Salter-Harris type-I fractures had the lowest rate of growth disturbance (36%). Children who had displaced fractures also were found to have a much higher rate of growth disturbance in comparison with children who had nondisplaced fractures. This article provides important information that can be used for counseling the parents of patients with these injuries regarding the risk of growth arrest and the need for continuing follow-up and possible referral.

**Cavusoglu AT, Er MS, Inal S, Ozsoy MH, Dincel VE, Sakaogullari A.** Pin site care during circular external fixation using two different protocols. *J Orthop Trauma.* 2009;23:724-30.

The authors compared two methods of pin-site care for pins associated with Ilizarov external fixation. After fifteen days, one group began daily showering and brushing of the pins with soap and a toothbrush, whereas the other group began daily showering but continued cleaning the pins with gauze and iodine. Both groups had identical pin-site treatment (gauze and iodine) for the first fifteen days. No significant differences were found between the groups in terms of the rates of superficial or deep infection. This article provides useful information that the need for specialized pin care is not necessary and that patients can easily care for their own pin sites.

**Clinton J, Franta A, Polissar NL, Neradilek B, Mounce D, Fink HA, Schousboe JT, Matsen FA 3rd.** Proximal humeral fracture as a risk factor for subsequent hip fractures. *J Bone Joint Surg Am.* 2009;91:503-11.

Eight thousand and forty-nine white women over the age of sixty-five years were followed for a mean of 9.8 years. Of the women who had sustained a proximal humeral fracture, 13.7% sustained a subsequent hip fracture within this follow-up period. The odds ratio for hip fracture in patients with a previous humeral fracture was 1.57. Interestingly, the risk of hip fracture was very high in the first year after humeral fracture (odds ratio, 6.16) but was not significant in subsequent years. These data provide useful information for counseling patients and should provide a reminder for orthopaedists of the need to initiate the evaluation and treatment of osteoporosis in women presenting with a proximal humeral fracture.

**Ekrol I, Court-Brown C, Ralston S, McQueen M.** Do antioxidants modulate the outcome of fractures? A prospective randomized controlled trial. Read at

the Annual Meeting of the Orthopaedic Trauma Association; 2009 Oct 7-10; San Diego, CA. Paper no. 54.

The authors investigated the effects of vitamin-C supplementation on patients with distal radial fractures. Vitamin-C supplementation was not found to be associated with lower rates of chronic regional pain syndrome, nor was it associated with improved patient outcomes. This information will be useful when orthopaedic surgeons are asked to provide antioxidant treatment for patients with wrist fractures.

**Gardner MJ, Farrell ED, Nork SE, Segina DN, Roult ML Jr.** Percutaneous placement of iliosacral screws without electrodiagnostic monitoring. *J Trauma.* 2009;66:1411-5.

The results of iliosacral screw placement without electrodiagnostic monitoring were reported with reference to neurologic injuries and screw placement. The authors reported the results for sixty-eight patients who had been managed with 106 percutaneous iliosacral screws. Twenty-six AO/OTA type-B injuries were included in this series. Patients requiring an open reduction were excluded. All patients had normal findings on preoperative neurologic examination. The results of postoperative computed tomography scans revealed no extrasosseous screws and postoperative neurologic examination revealed no motor or sensory deficits, suggesting that in experienced centers, electrodiagnostic monitoring is not needed during iliosacral screw fixation. This article demonstrates that routine neurologic monitoring is not useful in the hands of a very experienced pelvic surgeon. It does not indicate whether such monitoring is of benefit for less-experienced surgeons.

**Kropman RH, Bemelman M, Segers MJ, Hammacher ER.** Treatment of impacted greenstick forearm fractures in children using bandage or cast therapy: a prospective randomized trial. *J Trauma.* 2010;68:425-8.

The authors compared bandage and cast therapy for the treatment of impacted greenstick fractures of the distal part of the forearm. Patients managed with bandage therapy had more pain in the first week but overall had fewer symptoms of discomfort (i.e., itching). Patients managed with bandage therapy also had improved wrist range of motion at four weeks, but no difference between groups was apparent at six weeks. This article shows that sometimes less is more and that for stable torus fractures, simple protection of the limb is all that is necessary.

**McNamara I, Sharma A, Prevost T, Parker M.** Symptomatic venous thromboembolism following a hip fracture. *Acta Orthop.* 2009;80:687-92.

Five thousand three hundred consecutive hip fracture patients who were admitted to a single hospital in the United Kingdom are described. All patients received thromboprophylaxis with either unfractionated heparin (5000 units twice a day, for patients managed from 1989 to 1992) or low-molecular-weight heparin (Lovenox) (40 mg subcutaneously once daily, for patients managed from 1992 to 2007) beginning at the time of admission and con-

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tinuing for fourteen days after surgery. The overall rate of symptomatic venous thromboembolism was 2.2%, with 85% of cases occurring within five weeks after the injury. The authors found that patients with intertrochanteric or subtrochanteric fractures were twice as likely to develop symptomatic venous thromboembolism as patients with intracapsular fractures, a difference that has not been reported before. Other risk factors that were found to be independently associated with an increased risk of symptomatic venous thromboembolism in this study were living in one's own home and having elevated hemoglobin at the time of admission. This article quantifies the risk of venous thromboembolism in elderly patients and provides some data on the effectiveness of routine anticoagulation, which should be continued for at least four weeks after surgery.

**Modi CS, Nancoo T, Powers D, Ho K, Boer R, Turner SM.** Operative versus nonoperative treatment of acute undisplaced and minimally displaced scaphoid waist fractures—a systematic review. *Injury*. 2009;40:268-73.

Twelve studies that passed the review criteria were analyzed, and the authors report that the evidence suggests that percutaneous fixation of the scaphoid results in faster healing by five weeks and faster return to sport and work by seven weeks as compared with cast treatment. These differences did not exist when open reduction and fixation was compared with casting. There was a 30% rate of minor complications in the open reduction and internal fixation group, and manual workers required significantly more time off work than others, regardless of the method of treatment. The authors concluded that the majority of these injuries can be treated with casts with good results and that surgery should be reserved for patients who are unable to work in a cast and most manual laborers and high-level athletes. These data indicate that the main benefit to surgery may be a faster recovery, with the overall risk-benefit ratio favoring percutaneous fixation as compared with open surgery.

**Obreskey WT, Bauer R, Abraham C, Anderson V, Song Y, Archer K, Guillamondegui O, Jackson JC, Ely EW.** A prospective study of cognitive deficits, depression and posttraumatic stress disorder (PTSD) in trauma patients without intracranial injury. Read at the Annual Meeting of the Orthopaedic Trauma Association; 2009 Oct 7-10; San Diego, CA. Paper no. 74.

Residual cognitive and emotional effects were investigated in 174 severely injured patients who had been admitted to the intensive care unit and had an Injury Severity Score of >16. No patient had evidence of an intracranial hemorrhage on computed tomography scanning of the head. Patients were evaluated between twelve and twenty-four months after the injury and were assessed with cognitive, emotional, and functional instruments. Fifty-three percent of patients were found to have some cognitive impairment, 41% had symptoms of depression, and 26% had symptoms of posttraumatic stress disorder. These findings should raise awareness, among those who care for trauma patients, of the high prevalence of persistent cognitive and emotional impairment. This article confirms studies reported by others in recent years and

suggests that mental health issues should be routinely addressed in the care of orthopaedic trauma patients.

**Sankey RA, Turner J, Lee J, Healy J, Gibbons CE.** The use of MRI to detect occult fractures of the proximal femur: a study of 102 consecutive cases over a ten-year period. *J Bone Joint Surg Br*. 2009;91:1064-8.

Ninety-eight patients with negative findings on radiographs but with a history and physical examination findings that were consistent with a proximal femoral fracture underwent magnetic resonance imaging. A 1.0-T magnetic resonance imaging scanner was utilized for the first five years of the study period, whereas a 1.5-T magnetic resonance imaging scanner was utilized for the last five years. Eighty-three percent of the patients had an abnormality identified on magnetic resonance imaging, and 43% had a fracture of the proximal part of the femur. A very large number of pelvic ring fractures were identified as well. Interestingly, no fractures of the proximal part of the femur were identified in patients who also had a fracture of the pelvic ring. These data provide evidence that magnetic resonance imaging is the imaging modality of choice for the definitive diagnosis of radiographically occult fractures of the hip and pelvis. It does not demonstrate whether the early and definitive diagnosis of these injuries changes outcome or is cost-effective.

**Sayegh FE, Kenanidis EI, Papavasiliou KA, Potoupanis ME, Kirkos JM, Kapetanios GA.** Reduction of acute anterior dislocations: a prospective randomized study comparing a new technique with the Hippocratic and Kocher methods. *J Bone Joint Surg Am*. 2009;91:2775-82.

The authors describe a new method of closed reduction of anterior glenohumeral dislocations. The new method was compared with two older techniques and was found to be more successful and quicker and to result in less pain to the patient. Surgeons treating shoulder dislocations should be familiar with this method.

**Stannard JP, Volgas DA, Stewart RL, Alonso JE.** Incisional negative pressure wound therapy as a treatment for draining hematomas: a prospective randomized study. Read at the Annual Meeting of the Orthopaedic Trauma Association; 2009 Oct 7-10; San Diego, CA. Paper no. 72.

The authors performed a randomized study in which incisional negative-pressure wound therapy was compared with compression dressings for the treatment of hematomas with persistent drainage five days after fracture fixation. Patients with wounds still draining on the tenth postoperative day were taken back to the operating room as per the study protocol. Ninety-three patients with ninety-six draining hematomas were included in the study. There was no significant difference in the percentage of patients who required return to the operating room on the tenth postoperative day. There was a trend for patients who were managed with incisional negative-pressure wound therapy to have a lower rate of infected hematoma. These data question the routine use of negative-pressure wound therapy when there is draining hematoma, suggesting that its use is more appropriate for patients with serous, superficial drainage.