

Washington University School of Medicine Digital Commons@Becker

Open Access Publications

2015

What's new in Orthopaedic Trauma

William M. Ricci

Washington University School of Medicine in St. Louis

James C. Black

Washington University School of Medicine in St. Louis

Christopher M. McAndrew

Washington University School of Medicine in St. Louis

Michael J. Gardner

Washington University School of Medicine in St. Louis

Follow this and additional works at: https://digitalcommons.wustl.edu/open_access_pubs

Recommended Citation

Ricci, William M.; Black, James C.; McAndrew, Christopher M.; and Gardner, Michael J., "What's new in Orthopaedic Trauma." *The Journal of Bone and Joint Surgery*.97,14. 1200-1207. (2015).
https://digitalcommons.wustl.edu/open_access_pubs/4003

This Open Access Publication is brought to you for free and open access by Digital Commons@Becker. It has been accepted for inclusion in Open Access Publications by an authorized administrator of Digital Commons@Becker. For more information, please contact engeszer@wustl.edu.

SPECIALTY UPDATE

What's New in Orthopaedic Trauma

William M. Ricci, MD, James C. Black, MD, Christopher M. McAndrew, MD, MSc, and Michael J. Gardner, MD

This update presents a synopsis of the most clinically relevant high-quality studies related to orthopaedic trauma from the past twelve months. Key methods (◆), results (➤), and take-home points (★) for these studies are presented.

Clavicular Fractures

- ◆ With the use of administrative databases from Ontario, Canada, factors associated with reoperation and other complications after open reduction and internal fixation (ORIF) of midshaft clavicular fractures were identified in 1350 patients¹.
- At least one reoperation occurred in 24.6% of the patients, the most common being implant removal (18.8%; females were at highest risk, with an odds ratio [OR] of 1.7). Reoperation due to nonunion, deep infection, and malunion occurred in 2.6%, 2.6%, and 1.1% of patients, respectively. Risk factors for nonunion included female sex (OR, 2.2) and a high comorbidity score (OR, 2.8).
- ★ Reoperation after ORIF of the clavicle is common, occurring in one of four patients, as found in this study. Reoperations for reasons other than prominent hardware removal were uncommon.
- ◆ Forty-six patients with acute clavicular fractures were evaluated to determine if measurements of fracture displacement and shortening were different between upright and supine radiographic examinations².
- Fracture displacement was 89% greater when measured on upright radiographs. There was an average of 3 mm of shortening on upright images and 1.3 mm of lengthening on supine images.

Specialty Update has been developed in collaboration with the Board of Specialty Societies (BOS) of the American Academy of Orthopaedic Surgeons.

- ★ Upright radiographs showed more displacement and shortening than did supine radiographs, suggesting that upright radiographs better demonstrate clavicular displacement.

Proximal Humeral Fractures

- ◆ Results of reverse shoulder arthroplasty for the nonunion of a proximal humeral fracture were studied in thirty-two patients at a mean of four years³.
- The mean Constant score increased from 14.2 to 46.6 points. Range of motion also increased, from a mean of 42.9° to 109.7° of flexion and 0.5° to 13.1° of external rotation. There were complications in 41% of the patients, leading to nine revisions. The most common complication was a dislocation (34%), which was associated with resection of the humeral head fragment and the tuberosities.
- ★ Reverse shoulder arthroplasty for proximal humeral nonunion is associated with improved clinical outcomes but also with a high rate of dislocations related to resection of the tuberosities.
- ◆ A prospective randomized study compared the deltopectoral (n = 60) with the deltoid-split (n = 60) approach used for proximal humeral fractures treated with ORIF⁴.
- No differences in complications, rate of reoperations, Constant scores, or pain at one year were found.
- ★ The deltoid-split and deltopectoral approaches result in similar patient outcomes for the treatment of proximal humeral fractures.

Distal Humeral and Elbow Fractures

- ◆ Elbow range of motion, triceps extension strength, and functional outcome via the DASH (Disabilities

Disclosure: One or more of the authors received payments or services, either directly or indirectly (i.e., via his or her institution), from a third party in support of an aspect of this work. In addition, one or more of the authors, or his or her institution, has had a financial relationship, in the thirty-six months prior to submission of this work, with an entity in the biomedical arena that could be perceived to influence or have the potential to influence what is written in this work. Also, one or more of the authors has a patent or patents, planned, pending, or issued, that is broadly relevant to the work. No author has had any other relationships, or has engaged in any other activities, that could be perceived to influence or have the potential to influence what is written in this work. The complete **Disclosures of Potential Conflicts of Interest** submitted by authors are always provided with the online version of the article.

WHAT'S NEW IN ORTHOPAEDIC TRAUMA

of the Arm, Shoulder and Hand) score were retrospectively studied in AO/OTA type-A distal humeral fractures treated with a triceps-split or a triceps-sparing approach⁵.

- Union was achieved in all fractures. The triceps-sparing cohort had greater elbow flexion [mean [and standard deviation] of $143^\circ \pm 7^\circ$ compared with $130^\circ \pm 12^\circ$ for split; $p = 0.03$) and less extension contracture ($6^\circ \pm 8^\circ$ compared with $23^\circ \pm 4^\circ$ for split; $p < 0.0001$). Triceps strength favored the triceps-sparing approach ($p = 0.007$). No difference was found in DASH scores between the cohorts ($p = 0.333$).
- ★ For extra-articular distal humeral fractures, a triceps-sparing approach can yield better elbow range of motion and triceps strength. Both approaches were shown to result in reliable union and similar functional outcome.
- ◆ A retrospective study in Edinburgh, Scotland, evaluated short and long-term outcomes of primary nonoperative management of isolated displaced olecranon fractures in forty-three elderly patients (mean age, seventy-six years)⁶.
- At short-term follow-up (mean, four months), the mean Broberg and Morrey Elbow Score was 83 (range, 48 to 100), with 72% of the patients having good to excellent outcomes. No patients needed surgery for nonunion. In twenty-three patients available for long-term follow-up (mean, six years), the mean DASH score was 2.9 (range, 0 to 33.9) and the mean Oxford Elbow Score was 47 (range, 42 to 48). Ninety-one percent of the patients expressed satisfaction with their results.
- ★ For low-demand elderly patients, nonoperative treatment of a displaced olecranon fracture can yield satisfactory short and long-term outcomes comparable with those noted in the available literature on outcomes after operative management⁶.

Pelvic and Acetabular Fractures

- ◆ One hundred and eleven surgeons evaluated radiographs and computed tomography (CT) scans of twenty-seven lateral compression pelvic fractures of varying severity. Agreement for operative indications was determined among the surgeons⁷.
- Substantial agreement was demonstrated for only 33% of the cases, and overall agreement was fair ($\kappa = 0.39$). Years in practice and annual case volume did not correlate with surgical indications.
- ★ Much remains to be done regarding the description, subclassification, and surgical indications for lateral compression pelvic injuries. There is currently wide variation in practice with no high-level data guiding the decision for surgical intervention.

- ◆ One hundred and four patients with an “intermediate severity” lateral compression type-1 pelvic fracture (complete sacral fracture with <1 cm of initial displacement) were treated nonoperatively. Fifty patients were assessed for functional status (Majeed score) at a minimum of fifteen months, and thirty-six were assessed radiographically⁸.
- Eighty-four percent of the patients had good or excellent outcomes. Ninety-five percent of the patients without a lower-extremity injury had good or excellent outcomes. No fracture displaced to >1 cm.
- ★ This “intermediate severity” group of lateral compression pelvic fractures appears amenable to nonoperative treatment, with acceptable outcomes overall and minimal progressive displacement.
- ◆ Forty-six patients who were sixty years of age or older and treated with ORIF for a displaced acetabular fracture were assessed retrospectively to determine the rate of conversion to total hip arthroplasty. Functional outcomes were determined by phone interview⁹.
- Twenty-eight percent were converted to arthroplasty at an average of 2.5 years after acetabular ORIF. WOMAC (Western Ontario and McMaster Universities Osteoarthritis Index) scores were better than those of patients with established osteoarthritis, and Short Form (SF)-8 scores were similar to age-matched normal scores. The one-year mortality rate was 25%.
- ★ This study could serve as a guideline for use with patients during operative decision-making. Interestingly, another recent study reported that patients who were converted to arthroplasty had much worse outcomes compared with a control group who underwent arthroplasty for primary osteoarthritis¹⁰.

Hip Fractures

- ◆ A large national database (the American College of Surgeons National Surgical Quality Improvement Program [ACS NSQIP] database) was queried for all patients seventy years of age or older who were treated for an intertrochanteric hip fracture between 2009 and 2012. A total of 4432 patients were identified; 64% were treated with use of a nail, and 36%, with a screw and side plate. Multiple outcomes at a maximum of thirty days were analyzed¹¹.
- Length of stay was shorter for patients treated with a nail (5.4 versus 6.5 days; $p < 0.001$). There were no differences in operative time, complications, or readmissions.
- ★ Multiple randomized trials have demonstrated minimal clinical differences between the devices¹¹. A shorter length of stay may offset variable increased cost of the nail implant.

WHAT'S NEW IN ORTHOPAEDIC TRAUMA

Femoral Shaft Fractures

- ◆ Multiple studies that included the same prospective cohort of 417 patients investigated femoral rotation after treatment with intramedullary rods, with the use of postoperative CT to compare the injured and uninjured sides¹²⁻¹⁵.
- When considering time of day, trauma fellowship training, surgeon experience, patient body mass index (BMI), and rod entry site, the only significant difference in rotational malreduction was seen in a subset of ballistic fractures with higher degrees of comminution (Winquist 3 or 4).
- ★ Low rates of clinically important femoral malrotation can be achieved with careful evaluation while using intramedullary fixation. There do not appear to be patient, injury, or surgical variables that increase the risk for malrotation other than increasing comminution.
- ◆ Use of electromagnetic targeting in the placement of femoral rod locking bolts was evaluated in a randomized clinical trial in which antegrade rods were used in fracture treatment¹⁶ and in a cadaveric study involving the use of retrograde rods¹⁷.
- Decreased radiation doses were seen when using electromagnetic targeting (231 versus 690 μ Gy; $p < 0.05$), with no differences in operative time and failure rate noted, in the clinical study of antegrade rods. Electromagnetic targeting resulted in shorter times of insertion (311 versus 405 seconds; $p < 0.05$) in the cadaveric study of retrograde rods.
- ★ Electromagnetic targeting for the application of locking bolts in femoral rods was shown to decrease radiation exposure and may decrease surgical time when applying proximal locking bolts in retrograde rods.
- ◆ A retrospective cohort of forty-eight patients treated with closed intramedullary rod fixation of Type-B or C femoral shaft fractures was divided into two groups on the basis of displacement of wedge and comminuted segments (>10 mm or <10 mm)¹⁸.
- Complete radiographic union by twelve months was seen in twenty-two (76%) of the patients in the small-gap group and four (21%) of the patients in the large-gap group. Modified RUST (Radiographic Union Score for Tibial fractures) scores were lower at all time points for the large-gap group. The presence of a “reversed” wedge fragment increased the likelihood of nonunion and multiple surgical attempts for repair.
- ★ The presence of gaps of >10 mm between fracture fragments and “reversed” fragments after closed intramedullary rod fixation is associated with lower healing rates, and surgeons should consider direct reduction or indirect percutaneous fragment manipulation in such cases.

Distal Femoral Fractures

- ◆ A prospective cohort study of thirty-one distal femoral fractures treated with a dynamic locking plate construct was undertaken to measure union rate and callus formation¹⁹.
- Healing, judged by two reviewers using twelve-week CT scans and digitized radiographs with quantitative imaging analysis, was achieved in thirty (97%) of the fractures, with only one revision for malalignment, one nonunion repair, and no case demonstrating failure of proximal fixation.
- ★ Proximal fixation with the use of far cortical locking screws to dynamize bridge-plate fixation across distal femoral fractures appears safe and produces better healing results than in previous studies in which standard locking implants were used¹⁹.
- ◆ A retrospective cohort study of 335 distal femoral fractures treated with precontoured lateral distal femoral locking plates was performed to identify risk factors for reoperation²⁰.
- Reoperation occurred for nonunion in sixty-four (19%) of the cases, for infection in seventeen (5%), and for implant failure in twenty-five (7%). Independent risk factors for nonunion and infection were diabetes and open fracture, and risk factors for implant failure were smoking, open fracture, higher BMI, and shorter plates.
- ★ Pretreatment factors (diabetes, BMI, smoking, open fracture) increase the risk for complications following distal femoral fracture. Use of shorter plates was the only surgeon-controlled factor associated with complications following the treatment of distal femoral fractures.

Tibial Plateau Fractures

- ◆ Members of a large cohort of patients (8426) who received operative treatment of a displaced tibial plateau fracture were matched to 33,698 control patients. The rates of subsequent total knee arthroplasty after tibial plateau fracture were compared with those of the general population at two, five, and ten years²¹.
- After adjustment for comorbidities, tibial plateau fracture surgery significantly increased the likelihood of total knee arthroplasty (hazard ratio [HR], 5.29; $p < 0.0001$). Higher rates of knee arthroplasty were associated with increasing age (HR, 1.03 per year over the age of forty-eight; $p < 0.0001$), bicondylar fracture (HR, 1.53; $p < 0.0001$), and greater comorbidity (HR, 2.17; $p < 0.0001$).
- ★ Ten years after tibial plateau fracture surgery, 7.3% of the patients had had a total knee arthroplasty, corresponding with a 5.3-fold increase in the need for arthroplasty compared with the general population.

WHAT'S NEW IN ORTHOPAEDIC TRAUMA

Older patients and more severe fracture patterns are more likely to result in subsequent total knee arthroplasty.

- ◆ Forty patients with intra-articular tibial plateau fractures treated operatively were randomized to the use of continuous passive motion (CPM) or standardized physical therapy in the first forty-eight hours postoperatively²².
- There was no significant difference in knee extension at any time point (forty-eight hours, two weeks, six weeks, three months, and six months postoperatively). Knee flexion was significantly greater at forty-eight hours in the CPM group ($p < 0.005$), but no difference was found at later time points. There were no significant differences in pain, outcome measures, or complications at the six-month follow-up. Six of twenty patients in the CPM cohort did not tolerate the use of the device because of pain.
- ★ The use of CPM in the immediate postoperative period after ORIF for tibial plateau fractures did not offer any lasting benefit with regard to knee range of motion or other clinical outcome measures.

Tibial Shaft Fractures

- ◆ A retrospective study compared the infection risk when internal fixation plates did and did not overlap previous external fixator pin sites in patients with bicondylar tibial plateau fractures ($n = 85$) and distal tibial pilon fractures ($n = 97$)²³.
- Fifty of the 182 study patients had overlapping pin sites. Overall, twenty-five patients (14%) developed a deep wound infection: twelve (24%) of the fifty patients in the overlapping cohort compared with thirteen (10%) of the 132 in the nonoverlapping cohort ($p = 0.033$).
- ★ Placement of plates for definitive fixation that overlap previous external fixator pin sites significantly increases the risk of deep infection in the staged treatment of bicondylar tibial plateau and pilon fractures.
- ◆ A retrospective study examined the association between the timing of antibiotic administration and the development of deep infection in Type-III open tibial fractures²⁴.
- Among a study population of 137 patients, the authors found that age, smoking, diabetes, injury severity score, type-IIIA versus type-IIIB/C injury, and time to surgical debridement were not associated with infection. Greater than five days to wound coverage ($p < 0.01$) and greater than sixty-six minutes to initial prophylactic antibiotic dose ($p < 0.01$) were significant predictors of infection.

- ★ The times from injury to antibiotic administration and to wound coverage were independent predictors of the development of infection in type-III open tibial fractures.

Distal Tibial Fractures

- ◆ A prospective randomized trial investigated the use of angular stable locking screws versus conventional locking screws for intramedullary nailing of distal tibial fractures²⁵.
- One hundred and forty-two patients were allocated to two groups: seventy-five received the angular stable locking system and sixty-seven, conventional nailing. Outcome scores and clinical assessments were completed at six weeks, twelve weeks, six months, and one year post-surgery. The primary outcome measure was time to full weight-bearing with minimal pain. No differences were found for primary or secondary outcome measures between the groups for the entire study period.
- ★ The use of angular stable locking screws with intramedullary nailing in the treatment of distal tibial fractures did not improve short-term outcomes compared with the use of conventional locking screws.
- ◆ A retrospective review studied outcomes of fifty intra-articular distal tibial fractures treated with intramedullary nailing²⁶.
- In thirty-seven (74%) of the patients, reduction and internal fixation of the intra-articular extension was completed before nailing. Fibular fixation was utilized in thirty-two (64%) of the fractures. Routine dynamization was performed in all cases at a mean of ten weeks postoperatively. The mean follow-up was forty-two months (range, thirty-five to fifty-four months). All fractures healed at a mean of 16.3 weeks and anatomic articular reduction was maintained. The mean Olerud-Molander score was 92.8 (range, 80 to 100), and the mean Short Musculoskeletal Function Assessment (SMFA) score was 34.55 (range, 0.8 to 96), with 92% of the patients able to return to pre-injury activity levels.
- ★ Intramedullary nailing with minimal internal fixation is a reliable treatment option for distal tibial fractures with simple intra-articular extension.

Calcaneal Fractures

- ◆ Eight to twelve-year results from a randomized trial of operative compared with nonoperative treatment of displaced calcaneal fractures were analyzed. The fifty-six patients were divided into two groups on the basis of superior or inferior results, and multiple factors were compared between the groups²⁷.
- Operative treatment, a higher Böhler angle postoperatively, and articular restoration were significantly

WHAT'S NEW IN ORTHOPAEDIC TRAUMA

associated with a better outcome. The pretreatment Böhler angle and fracture type were similar between groups.

- ★ Treatment decisions regarding calcaneal fractures are complex and remain unclear. The post-hoc analysis of a randomized trial demonstrated better long-term outcomes among those who had been treated operatively, as well as for those with more accurate reduction of the articular surface and calcaneal shape.
- ◆ One hundred and eight displaced intra-articular calcaneal fractures were evaluated at a minimum of ten years of follow-up to determine if the Sanders classification was prognostic of long-term outcome²⁸.
- Subtalar fusion was required in 19% of type-2 fractures and 47% of type-3 fractures. Of the nonfused group, 77% were within the U.S. population norm of the SF-36 PCS (Physical Component Summary) score.
- ★ Good or excellent results were achieved in the majority of patients, all of whom were treated with a nonlocked plate without augmentation. The Sanders classification remains prognostic at long-term follow-up.
- ◆ Thirty-one patients with Sanders type-4 calcaneal fractures were randomized to undergo either ORIF or ORIF with primary subtalar fusion. Functional outcomes were determined at a minimum of two years of follow-up²⁹.
- Only one of the ORIF patients required a secondary fusion during the study period. No significant differences were found in any of the multiple outcome measures between the groups.
- ★ The authors note that, despite the lack of functional differences found, ORIF with primary fusion may provide quicker healing and obviates the need for late secondary fusion with the associated costs and lost work time.

Polytrauma

- ◆ The in-hospital mortality rate associated with bilateral femoral fractures (BFFs) for a contemporary cohort was compared with that for patients with unilateral fractures and with previous rates from the same center³⁰.
- In-hospital mortality for patients with BFFs was 7% in the modern cohort compared with 2% for contemporary patients with unilateral fractures and 26% for patients with BFFs treated two decades ago at the same center.
- ★ BFFs are associated with higher in-hospital mortality compared with unilateral fractures. Improvements in automobile safety and changes in the delivery of trauma care have likely contributed to the decrease in overall mortality seen when com-

paring this modern cohort with a historical cohort from the same center.

Mental Health Outcomes of Orthopaedic Trauma

- ◆ A prospective cohort of 152 patients completed pain, function, and depression questionnaires at one to two months after operative treatment of one or more fractures, and 136 patients completed the questionnaires again at five to eight months to evaluate the prevalence of depression and posttraumatic stress disorder (PTSD), and their relation to pain and disability³¹.
- Thirty-five (23%) and twenty-nine (21%) met the criteria for depression at time 1 and time 2, respectively. PTSD scores decreased (mean, 28.3 to 26.1; $p < 0.05$) with statistical, but questionable clinical, significance. Catastrophic thinking was associated with worse pain at both time points, and anxiety was the sole predictor of disability at time 1.
- ★ Psychological challenges are highly prevalent in populations with orthopaedic injuries, and treatable factors, specifically catastrophic thinking, are associated with worse mid-term outcomes.
- ◆ A prospective cohort study of 110 patients who were admitted with orthopaedic injuries was undertaken to determine the prevalence of depression at the time of injury and analyze factors associated with continued depression nine months thereafter³².
- Twenty-two (20%) had moderate-to-major depression, and thirty-six (33%) had mild depression according to Patient Health Questionnaire scores at the time of injury. At nine months, 17% had mild depression and 23% had moderate-to-major depression. Persistent depression was associated with higher screening scores, Medicaid insurance status, and prior psychiatric diagnosis, while employment had a protective effect.
- ★ The risk of persistent depression after musculoskeletal injury is associated with higher screening scores, insurance status, and prior psychiatric history. Patients with these factors may benefit from targeted psychosocial intervention at the time of injury.

Infection and Open Fracture Management

- ◆ Deep infection after immediate or delayed primary wound closure for Grade-I, II, and IIIA open fractures was analyzed retrospectively for 146 open fractures (seventy-three matched pairs)³³.
- Deep infection occurred in 4.1% of fractures treated with immediate closure and in 17.8% of fractures treated with delayed primary closure.
- ★ In properly selected open fracture wounds, immediate closure after thorough debridement appears

WHAT'S NEW IN ORTHOPAEDIC TRAUMA

safe and is associated with a lower infection rate compared with delayed primary closure.

- ◆ The effect of a performance-improvement program designed for open fracture care was evaluated in a study comparing the management of 127 patients with open fractures before program implementation with that of 132 patients after implementation³⁴.
- The performance-improvement program resulted in shorter times to antibiotic administration and physician evaluation and improved antibiotic dosing.
- ★ A multifaceted performance-improvement program was very effective in improving early treatment of patients with open fractures.
- ◆ The association between the time to surgery and the development of deep infection in open fractures was evaluated in a prospective cohort of 737 fractures between 2001 and 2009³⁵.
- Infection developed in 6%. The median time to surgery was nine hours and four minutes for those without infection and seven hours and thirty-nine minutes for those with infection. Multivariate regression analysis found no association between infection and time to surgery. The Gustilo grade was associated with infection.
- ★ Injury severity, not time to surgery, was associated with deep infection after open fracture.

Basic Science of Fracture Fixation Biomechanics

- ◆ Locking screws were inserted at a standard torque through bent plate holes. Screw stability was tested at plate angulations through a screw hole of 5°, 15°, and 45°³⁶.
- Screws inserted into plates with holes bent 15° and 45° were significantly less stable than controls. Survival was not significantly less in the 5° group ($p = 0.17$). Placement of a locking cap insert prior to bending did not affect the decreased stability caused by plate bending.
- ★ Plate bending of >5° was shown to significantly affect the function and stability of locking screws. In light of these findings, surgeons should weigh the importance of plate contouring versus the necessity of locking screws in that fracture segment. A simi-

lar study also found that plate contouring at a 5° angle did not affect strength, but all greater angles did, and any amount of off-axis screw insertion decreased stability compared with orthogonal insertion³⁷.

Basic Science of Bone Healing

- ◆ With the use of a rat femoral defect model, the effects of combining low-intensity pulsed ultrasound (LIPUS) and recombinant human bone morphogenetic protein (rhBMP-2) were investigated³⁸.
- Combined with a low dose of rhBMP-2 (1.2 µg), LIPUS increased bone healing compared with sham treatment. With higher doses of rhBMP-2 (6 and 12 µg), LIPUS also increased bone quantity and strength.
- ★ LIPUS, which is essentially a mechanical perturbation on the cellular level, augmented healing further than the effects of rhBMP-2 alone. This may stimulate additional research toward identifying opportunities to achieve healing in critical-sized bone defects.

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 higher Level of Evidence grade. In addition to articles published previously in this journal or cited already in the Update, nine other articles with a higher Level of Evidence grade were identified that were relevant to orthopaedic trauma. A list of those titles is appended to this review after the standard bibliography. We have provided a brief commentary about each of the articles to help guide your further reading, in an evidence-based fashion, in this subspecialty area.

William M. Ricci, MD
James C. Black, MD
Christopher M. McAndrew, MD, MSc
Michael J. Gardner, MD
Department of Orthopaedic Surgery,
Washington University School of Medicine,
660 South Euclid Avenue,
Campus Box 8233,
St. Louis, MO 63110.
E-mail address for W.M. Ricci: ricciw@wustl.edu

References

1. Leroux T, Wasserstein D, Henry P, Khoshbin A, Dwyer T, Ogilvie-Harris D, Mahomed N, Veillette C. Rate of and risk factors for reoperations after open reduction and internal fixation of midshaft clavicle fractures: a population-based study in Ontario, Canada. *J Bone Joint Surg Am.* 2014 Jul 2;96(13):1119-25. Epub 2014 Jul 2.
2. Backus JD, Merriman DJ, McAndrew CM, Gardner MJ, Ricci WM. Upright versus supine radiographs of clavicle fractures: does positioning matter? *J Orthop Trauma.* 2014 Nov;28(11):636-41.
3. Raiss P, Edwards TB, da Silva MR, Bruckner T, Loew M, Walch G. Reverse shoulder arthroplasty for the treatment of nonunions of the surgical neck of the proximal part of the humerus (type-3 fracture sequelae). *J Bone Joint Surg Am.* 2014 Dec 17;96(24):2070-6.

4. Buecking B, Mohr J, Bockmann B, Zettl R, Ruchholtz S. Deltoid-split or deltopectoral approaches for the treatment of displaced proximal humeral fractures? *Clin Orthop Relat Res.* 2014 May;472(5):1576-85. Epub 2013 Dec 11.
5. Illical EM, Farrell DJ, Siska PA, Evans AR, Gruen GS, Tarkin IS. Comparison of outcomes after triceps split versus sparing surgery for extra-articular distal humerus fractures. *Injury.* 2014 Oct;45(10):1545-8. Epub 2014 Apr 16.
6. Duckworth AD, Bugler KE, Clement ND, Court-Brown CM, McQueen MM. Non-operative management of displaced olecranon fractures in low-demand elderly patients. *J Bone Joint Surg Am.* 2014 Jan 1;96(1):67-72.
7. Beckmann JT, Presson AP, Curtis SH, Haller JM, Stuart AR, Higgins TF, Kubiak EN. Operative agreement on lateral compression-1 pelvis fractures.

WHAT'S NEW IN ORTHOPAEDIC TRAUMA

A survey of 111 OTA members. *J Orthop Trauma*. 2014 Dec;28(12):681-5.

8. Gaski GE, Manson TT, Castillo RC, Slobogean GP, O'Toole RV. Nonoperative treatment of intermediate severity lateral compression type 1 pelvic ring injuries with minimally displaced complete sacral fracture. *J Orthop Trauma*. 2014 Dec;28(12):674-80.
9. O'Toole RV, Hui E, Chandra A, Nascone JW. How often does open reduction and internal fixation of geriatric acetabular fractures lead to hip arthroplasty? *J Orthop Trauma*. 2014 Mar;28(3):148-53.
10. Schnaser E, Scarcella NR, Vallier HA. Acetabular fractures converted to total hip arthroplasties in the elderly: how does function compare to primary total hip arthroplasty? *J Orthop Trauma*. 2014 Dec;28(12):694-9.
11. Bohl DD, Basques BA, Golinvaux NS, Miller CP, Baumgaertner MR, Grauer JN. Extramedullary compared with intramedullary implants for intertrochanteric hip fractures: thirty-day outcomes of 4432 procedures from the ACS NSQIP database. *J Bone Joint Surg Am*. 2014 Nov 19;96(22):1871-7.
12. Ayalon OB, Patel NM, Yoon RS, Donegan DJ, Koerner JD, Liporace FA. Comparing femoral version after intramedullary nailing performed by trauma-trained and non-trauma trained surgeons: is there a difference? *Injury*. 2014 Jul;45(7):1091-4. Epub 2014 Jan 30.
13. Koerner JD, Patel NM, Yoon RS, Gage MJ, Donegan DJ, Liporace FA. Femoral malrotation after intramedullary nailing in obese versus non-obese patients. *Injury*. 2014 Jul;45(7):1095-8. Epub 2014 Feb 26.
14. Patel NM, Yoon RS, Cantlon MB, Koerner JD, Donegan DJ, Liporace FA. Intramedullary nailing of diaphyseal femur fractures secondary to gunshot wounds: predictors of postoperative malrotation. *J Orthop Trauma*. 2014 Dec;28(12):711-4.
15. Patel NM, Yoon RS, Koerner JD, Donegan DJ, Liporace FA. Timing of diaphyseal femur fracture nailing: is the difference night and day? *Injury*. 2014 Mar;45(3):546-9. Epub 2013 Oct 26.
16. Maqungo S, Horn A, Bernstein B, Keel M, Roche S. Distal interlocking screw placement in the femur: free-hand versus electromagnetic assisted technique (Sureshot). *J Orthop Trauma*. 2014 Dec;28(12):e281-3.
17. Somerson JS, Rowley D, Kennedy C, Buttacavoli F, Agarwal A. Electromagnetic navigation reduces surgical time and radiation exposure for proximal interlocking in retrograde femoral nailing. *J Orthop Trauma*. 2014 Jul;28(7):417-21.
18. Lin SJ, Chen CL, Peng KT, Hsu WH. Effect of fragmentary displacement and morphology in the treatment of comminuted femoral shaft fractures with an intramedullary nail. *Injury*. 2014 Apr;45(4):752-6. Epub 2013 Oct 22.
19. Bottlang M, Fitzpatrick DC, Sheerin D, Kubiak E, Gellman R, Vande Zandschulp C, Doornink J, Earley K, Madey SM. Dynamic fixation of distal femur fractures using far cortical locking screws: a prospective observational study. *J Orthop Trauma*. 2014 Apr;28(4):181-8.
20. Ricci WM, Streubel PN, Morshed S, Collinge CA, Nork SE, Gardner MJ. Risk factors for failure of locked plate fixation of distal femur fractures: an analysis of 335 cases. *J Orthop Trauma*. 2014 Feb;28(2):83-9.
21. Wasserstein D, Henry P, Paterson JM, Kreder HJ, Jenkinson R. Risk of total knee arthroplasty after operatively treated tibial plateau fracture: a matched-population-based cohort study. *J Bone Joint Surg Am*. 2014 Jan 15;96(2):144-50.
22. Hill AD, Palmer MJ, Tanner SL, Snider RG, Broderick JS, Jeray KJ. Use of continuous passive motion in the postoperative treatment of intra-articular knee fractures. *J Bone Joint Surg Am*. 2014 Jul 16;96(14):e118. Epub 2014 Jul 16.

23. Shah CM, Babb PE, McAndrew CM, Brimmo O, Badarudeen S, Torretta P 3rd, Ricci WM, Gardner MJ. Definitive plates overlapping provisional external fixator pin sites: is the infection risk increased? *J Orthop Trauma*. 2014 Sep;28(9):518-22.
24. Lack WD, Karunakar MA, Angerame MR, Seymour RB, Sims S, Kellam JF, Bosse MJ. Type III open tibia fractures: immediate antibiotic prophylaxis minimizes infection. *J Orthop Trauma*. 2015 Jan;29(1):1-6.
25. Höntzsch D, Schaser KD, Hofmann GO, Pohlemann T, Hem ES, Rothenbach E, Krettek C, Attal R. Evaluation of the effectiveness of the angular stable locking system in patients with distal tibial fractures treated with intramedullary nailing: a multicenter randomized controlled trial. *J Bone Joint Surg Am*. 2014 Nov 19;96(22):1889-97.
26. Katsenis DL, Begkas D, Spiliopoulos G, Stamoulis D, Pogiati K. The results of closed intramedullary nailing for intra-articular distal tibial fractures. *J Orthop Trauma*. 2014 Feb;28(2):108-13.
27. Agren PH, Mukka S, Tullberg T, Wretenberg P, Sayed-Noor AS. Factors affecting long-term treatment results of displaced intra-articular calcaneal fractures: a post hoc analysis of a prospective, randomized, controlled multicenter trial. *J Orthop Trauma*. 2014 Oct;28(10):564-8.
28. Sanders R, Vaupel Z, Erdogan M, Downes K. The operative treatment of displaced intra-articular calcaneal fractures (DIACFs): long term (10-20 years) results in 108 fractures using a prognostic CT classification. *J Orthop Trauma*. Epub 2014 Jun 30.
29. Buckley R, Leighton R, Sanders D, Poon J, Coles CP, Stephen D, Paolucci EO. Open reduction and internal fixation compared with ORIF and primary subtalar arthrodesis for treatment of Sanders type IV calcaneal fractures: a randomized multicenter trial. *J Orthop Trauma*. 2014 Oct;28(10):577-83.
30. O'Toole RV, Lindbloom BJ, Hui E, Fiastro A, Boateng H, O'Brien M, Murphy L, Copeland CE. Are bilateral femoral fractures no longer a marker for death? *J Orthop Trauma*. 2014;28(2):77-81; discussion 81-2.
31. Vranceanu AM, Bachoura A, Weening A, Vrahas M, Smith RM, Ring D. Psychological factors predict disability and pain intensity after skeletal trauma. *J Bone Joint Surg Am*. 2014 Feb 5;96(3):e20.
32. Becher S, Smith M, Ziran B. Orthopaedic trauma patients and depression: a prospective cohort. *J Orthop Trauma*. 2014 Oct;28(10):e242-6.
33. Jenkinson RJ, Kiss A, Johnson S, Stephen DJ, Kreder HJ. Delayed wound closure increases deep-infection rate associated with lower-grade open fractures: a propensity-matched cohort study. *J Bone Joint Surg Am*. 2014 Mar 5;96(5):380-6.
34. Collinge CA, McWilliam-Ross K, Kelly KC, Dombroski D. Substantial improvement in prophylactic antibiotic administration for open fracture patients: results of a performance improvement program. *J Orthop Trauma*. 2014 Nov;28(11):620-5.
35. Weber D, Dulai SK, Bergman J, Buckley R, Beaupre LA. Time to initial operative treatment following open fracture does not impact development of deep infection: a prospective cohort study of 736 subjects. *J Orthop Trauma*. 2014 Nov;28(11):613-9.
36. Boulton CL, Kim H, Shah SB, Ryan SP, Metzger TA, Hsieh AH, O'Toole RV. Do locking screws work in plates bent at holes? *J Orthop Trauma*. 2014 Apr;28(4):189-94.
37. Gallagher B, Silva MJ, Ricci WM. Effect of off-axis screw insertion, insertion torque, and plate contouring on locked screw strength. *J Orthop Trauma*. 2014 Jul;28(7):427-32.
38. Angle SR, Sena K, Sumner DR, Virkum WW, Viridi AS. Combined use of low-intensity pulsed ultrasound and rhBMP-2 to enhance bone formation in a rat model of critical size defect. *J Orthop Trauma*. 2014 Oct;28(10):605-11.

Evidence-Based Articles Related to Orthopaedic Trauma

Benegas E, Ferreira Neto AA, Gracitelli ME, Malavolta EA, Assunção JH, Prada Fde S, Bolliger Neto R, Mattar R Jr. Shoulder function after surgical treatment of displaced fractures of the humeral shaft: a randomized trial comparing ante-grade intramedullary nailing with minimally invasive plate osteosynthesis. *J Shoulder Elbow Surg*. 2014 Jun;23(6):767-74. Epub 2014 Apr 24.

Forty patients (forty-one humeral shaft fractures) were randomized to treatment with minimally invasive plate fixation (n = 21) or interlocking intramedullary nailing (n = 19). Shoulder function was the primary outcome as measured with the UCLA (University of California, Los Angeles) Shoulder Scale. No difference was found in elbow function or shoulder function, and the complications were similar.

These findings indicate that there is no substantial difference between the two treatment options in terms of resulting shoulder function.

Levy J, Ernat J, Song D, Cook JB, Judd D, Shaha S. Outcomes of long-arm casting versus double-sugar-tong splinting of acute pediatric distal forearm fractures. *J Pediatr Orthop*. 2015 Jan;35(1):11-7.

Patients between the ages of four and twelve years were randomized to two treatment options over a two-year period: a long-arm cast or a double-sugar-tong splint. Seventy-one patients were enrolled (thirty-seven in the long-arm cast group and thirty-four in the double-sugar-tong splint group). Sagittal alignment immediately post-reduction and at two weeks showed that the double-sugar-tong splint group was slightly better (mean, 2° versus 5°, respectively). For the entire treatment period, there was an increased risk of a loss of reduction of ≥10° in the long-arm cast group. Although there were significant differences between the two groups with regard to risk of reduction loss, both treatments are considered appropriate immobilization for these pediatric fractures.

Testroote M, Stigter WA, Janssen L, Janzing HM. Low molecular weight heparin for prevention of venous thromboembolism in patients with lower-leg immobilization. *Cochrane Database Syst Rev*. 2014 Apr 25;4:CD006681.

With use of standard meta-analysis techniques, this study reviewed randomized controlled trials (RCTs) and controlled clinical trials (CCTs) that described thromboprophylaxis by means of low-molecular-weight heparin compared with no prophylaxis or placebo in adult patients with lower-leg

WHAT'S NEW IN ORTHOPAEDIC TRAUMA

immobilization. Six RCTs involving 1490 patients were included in the analysis. The rate of venous thromboembolism (VTE) ranged from 4.3% to 40% in patients who had a leg injury that had been immobilized in a plaster cast or a brace for at least one week and who received no prophylaxis or placebo. The number was significantly lower among patients who received daily subcutaneous injections of low-molecular-weight heparin during immobilization (OR, 0.49; 95% confidence interval [CI], 0.34 to 0.72).

The authors concluded that the use of low-molecular-weight heparin in outpatients significantly reduces VTE when immobilization of the lower leg is required.

Sun H, Luo CF, Zhong B, Shi HP, Zhang CQ, Zeng BF. A prospective, randomised trial comparing the use of absorbable and metallic screws in the fixation of distal tibiofibular syndesmosis injuries: mid-term follow-up. *Bone Joint J.* 2014 Apr;96-B(4):548-54.

A total of 168 patients with a mean age of 38.5 years were randomized to receive either polylevulactic acid screws (n = 86) or metallic screws (n = 82). The Baird scoring system was used to assess satisfaction and functional recovery postoperatively. The mean follow-up was 55.8 months. The functional scores were similar in the two groups at the final follow-up. Patients in the polylevulactic acid group had a greater mean dorsiflexion and plantar flexion of the injured ankle. In this group, eighteen patients had a foreign-body reaction that was mild and eight patients had a moderate reaction. In the metallic group, eight had a mild foreign-body reaction and no patient had a moderate reaction (p < 0.001). The authors concluded that both types of screws provide acceptable fixation and functional recovery; however, polylevulactic acid screws are associated with a higher incidence of foreign-body reaction.

Griffin XL, Parsons N, Achten J, Costa ML. The Targon femoral neck hip screw versus cannulated screws for internal fixation of intracapsular fractures of the hip: a randomised controlled trial. *Bone Joint J.* 2014 May;96-B(5):652-7.

One hundred and seventy-four participants who were sixty-five years of age or older and had a displaced or undisplaced intracapsular fracture of the hip were randomized to internal fixation with use of either a Targon femoral neck hip screw or standard cannulated screw. The absolute reduction in the risk of revision was 4.7% (95% CI, 14.2% to 22.5%) in favor of the Targon screw, which was less than the prespecified level of minimum clinically important difference. The authors found no evidence of a clinical difference in the risk of revision surgery between the Targon hip screw and the cannulated screw for fixation in patients with an intracapsular fractured hip.

Griffin D, Parsons N, Shaw E, Kulikov Y, Hutchinson C, Thorogood M, Lamb SE; UK Heel Fracture Trial Investigators. Operative versus non-operative treatment for closed, displaced, intra-articular fractures of the calcaneus: randomised controlled trial. *BMJ.* 2014 Jul 24;349:g4483.

One hundred and fifty-one patients with acute displaced intra-articular calcaneal fractures were randomly assigned to operative treatment (n = 73) or nonoperative treatment (n = 78). The main outcome measure was the patient-reported Kerr-Atkins score for pain and function. Secondary outcomes included complications of hindfoot pain and function as assessed by the American Orthopaedic Foot & Ankle Society (AOFAS) score, general health (SF-36), and quality of life (Euroqol [EQ]-5D). Ninety-five percent follow-up was achieved. There were no significant differences found between the treatment groups in the primary outcome or in any of the secondary outcomes. Complications and reoperations were

more common in those who received operative care (OR, 7.5; 95% CI, 2.0 to 41.8). The authors concluded that operative treatment by ORIF is not recommended.

Webster J, Scuffham P, Stankiewicz M, Chaboyer WP. Negative pressure wound therapy for skin grafts and surgical wounds healing by primary intention. *Cochrane Database Syst Rev.* 2014 Oct 7;10:CD009261.

The authors searched the standard profile of Cochrane databases as well as MEDLINE, EMBASE, and EBSCO CINAHL (Cumulative Index to Nursing and Allied Health Literature) databases to identify trials that allocated patients to treatment randomly and compared negative pressure wound therapy (NPWT) with any other type of wound dressing. Nine trials, including 785 participants, were aggregated. Seven trials compared NPWT with a standard dressing (two of the NPWT devices were "homemade"). One trial compared one homemade NPWT device with a commercially available device. The mean cost to supply equipment for NPWT was \$96.51 per day (U.S. dollars) compared with \$4.22 per day for one of the homemade devices. Labor costs were similar. The pain intensity score was lower in the homemade group compared with the NPWT group. The authors concluded that the evidence for the effectiveness of NPWT for reducing surgical site infections and wound dehiscence remains unclear, as does the effect of NPWT on the time to complete healing.

Dawson J, Kiner D, Gardner W 2nd, Swafford R, Nowotarski PJ. The reamer-irrigator-aspirator as a device for harvesting bone graft compared with iliac crest bone graft: union rates and complications. *J Orthop Trauma.* 2014 Oct;28(10):584-90.

This was a prospective randomized trial involving standard open iliac crest versus reamer-irrigator-aspirator (RIA) autograft. The outcome data included amount of graft, time of harvest, associated surgical cost, and function and pain as measured by the SMFA and a visual analog scale. Patients were followed for an average of 56.9 weeks. Eighty-six percent of the patients who received iliac crest bone graft (ICBG) united in an average of 22.5 weeks compared with 82.1% of those who received RIA, who healed in an average of 25.8 weeks. There was no difference in donor-site complications. Postoperative follow-up revealed that the RIA patients had significantly lower donor-site pain. The authors concluded that, when compared with autograft obtained from the iliac crest, autograft with use of RIA is similar. Using the RIA technique achieved similar union rates and less donor-site pain. RIA also yields a greater volume of graft compared with ICBG.

Venkatadass K, Balachandar G, Rajasekaran S. Is prone position ideal for manipulation and pinning of displaced pediatric extension-type supracondylar fractures of humerus?: a randomized control trial. *J Pediatr Orthop.* 2014 Nov 12. [Epub ahead of print].

Fifty-two children with acute, type-III supracondylar humeral fractures without vascular injury were randomized into the prone-position group (n = 26) and the supine-position group (n = 26) according to computer-generated block randomization. The duration of the procedure and the number of radiation exposures, attempts at closed reduction, and attempts at placing the pins were analyzed. Functional and radiographic outcomes were assessed at a minimum follow-up of one year. There were no significant differences in any of the outcomes between the supine and prone positions. The authors noted that closed displaced fractures with skin puckering are difficult to manipulate with the patient in the prone position and concluded that the supine position may be ideal for closed reduction and pinning for all patterns of type-III supracondylar fractures.