Guest Editorial

What's New in Pediatric Orthopaedic Surgery

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This update on pediatric orthopaedic surgery presents a review of related articles mostly from July 2018 to June 2019 from English-language journals, located using the U.S. PubMed website. Our goal was to provide information that will have a meaningful impact on the pediatric orthopaedic surgeon's daily clinical practice.

Trauma

A retrospective study of 309 pediatric patients who met the criteria for nonoperative management of a complete radial shaft fracture was conducted. The outcome measure was failure, defined by the residual angulation of the radius on follow-up radiographs. Patients with proximal third fractures were significantly more likely ($p < 0.0001$) to undergo failed conservative treatment. Seventy percent of the time (32 of 46 fractures), proximal third fractures exceeded angulation criteria. They had a 4.6 times (95% confidence interval [CI], 2.3 to 9.1 times) higher chance of failed closed reduction and casting[1].

The most common injuries preceding acute compartment syndrome in children are tibial shaft fractures. A retrospective review of 515 patients was performed to determine if there were patient or fracture characteristics that were significantly associated with acute compartment syndrome and to determine the frequency of acute compartment syndrome. Acute compartment syndrome developed in 1.7% of patients. Patient age of >14 years, comminuted or segmental fractures, motor vehicle or motorcycle accidents, higher body mass index (BMI), and concomitant orthopaedic injuries were all significantly associated with acute compartment syndrome[2].

A cervical spine clearance protocol developed in 2002 was revised in 2012 to include a next-day repeat physical examination, and it was revised again in 2014 to limit the use of computed tomographic (CT) scans. There were no missed or delayed diagnoses of a cervical spine injury during the study period. There was a decrease in the use of CT scans from 90% in 2011 to 28.7% in 2014, no increase in the hospital length of stay, and an increase in the time to the removal of the cervical collar[3].

The use of the intraoperative internal rotation stress test after the placement of 2 lateral pins may assist with decision-making for type-3 supracondylar humeral fractures. An intraoperative protocol for the fixation of these fractures was established to determine if the maintenance of reduction was improved using the internal rotation stress test prior to the medial pin fixation. Forty-nine fractures in the prospective internal rotation stress test protocol cohort were compared with 78 fractures in a retrospective cohort (before the internal rotation stress test). A major percentage of patients (>12%) had a rotational loss of reduction that was less common ($p = 0.02$) in the prospective cohort (no fractures) compared with the retrospective cohort (8 fractures). The loss of proximal fixation with need for reoperation occurred in 3 fractures in the retrospective cohort and no fractures in the prospective cohort ($p = 0.28$)[4].

Upper Extremity

Prior case series have shown variable intermediate-term and long-term results following release for posttraumatic elbow contractures in children. A retrospective review of 26 patients who underwent open release at a mean of 29 months following the injury was conducted. At a mean follow-up of 42 months, there were significant mean increases in both the active elbow flexion-extension rotation arc (49°) and the forearm rotation arc (70°). The final motion was not significantly different following the use of continuous passive motion ($n = 16$). Recurrent contractures developed in 2 patients[5].

Reddy and Ho retrospectively reviewed 51 pediatric patients with mallet fractures (38 acute fractures and 13 chronic fractures) treated with percutaneous reduction and pin fixation. The mean operative time was 31 minutes for acute fractures and 40 minutes for chronic fractures. At the final follow-up (mean, 78.5 days), all patients had healed, with no nonunion or volar subluxations. No patient had >10° extensor lag, and all patients achieved full active flexion. There were no infections, wire breakages, or unplanned returns for a surgical procedure. This surgical technique achieves favorable clinical

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What's New in Pediatric Orthopaedic Surgery

and radiographic results with minimal complications, even for chronic fractures[6].

The majority of phalangeal fractures in children are extra-articular and are treated nonoperatively. Vonlanthen et al. reviewed 365 fractures of the proximal and middle phalanges. The mean age at the time of injury was 9.7 years. No secondary angulation occurred in minimally displaced or nondisplaced fractures. The authors concluded that metaphyseal or diaphyseal fractures of proximal and middle phalanges with <10° of angulation are stable without the need for radiographic follow-up[7].

Surgical procedures to improve external rotation in children with brachial plexus birth palsy can result in loss of midline function. A retrospective review of 20 children with brachial plexus birth palsy who had previously undergone capsular release and tendon transfer to improve external rotation was performed. Using the modified Mallet scale, the internal rotation score decreased from a mean of 2.71 points preoperatively to 2.15 points postoperatively. Nine patients underwent subsequent derotational humeral osteotomy to improve midline function, with a mean correction of 47.8° (range, 20° to 85°). The modified Mallet scores for internal rotation improved to 2.7 points[8].

Sports

Two studies examined the incidence of symptomatic venous thromboembolism following knee arthroscopy in children. The first study, by Murphy et al., reviewed 2,783 patients who were 15 to 18 years of age and underwent knee arthroscopy during a 5-year period. Seven patients developed a symptomatic venous thromboembolism, for an incidence of 0.25%[9]. Similarly, in the second study, Lau et al. reviewed 746 patients (mean age, 15.2 years) and reported an incidence of symptomatic, confirmed venous thromboembolism of 0.27% after knee arthroscopy[10].

Meniscal preservation following tears in younger patients is important, as it may limit future joint degeneration. Clinical, radiographic, and surgical data were retrospectively collected on 280 adolescents with bucket-handle meniscal tears treated arthroscopically over 10 years. The authors assessed risk factors for reoperation and persistent pain. In 181 cases (65%), meniscal repair was performed, and in 103 cases (37%), a concurrent anterior cruciate ligament (ACL) surgical procedure was performed. Reoperation related to the original meniscal injury or surgical procedure was more common ($p = 0.001$) after meniscal repair (32%) than after meniscectomy (8%). Of 185 patients, 170 (92%) had pain relief at the final follow-up. A concurrent ACL surgical procedure was associated with a slower return to sports and a lower reoperation rate[11].

ACL reconstruction in the pediatric population continues to receive research attention. Obesity does not appear to be associated with an increased risk of graft rupture, contralateral injury, or new meniscal tear in the early follow-up. Overall, overweight and obese children sustained more meniscal tears and more irreparable tears after an ACL rupture than children with normal BMI[12]. Soft-tissue grafts used for ACL reconstruction may have higher failure rates, with a recent study showing that they were twice as likely to fail (13%) compared with patellar tendon grafts (6%) ($p < 0.001$)[13].

A matched cohort study compared 20 patients who underwent surgical fixation for displaced tibial eminence fractures with 40 patients who underwent ACL reconstruction to determine if clinical outcomes, return to play, or reinjury rates were different. Postoperatively, the tibial eminence fracture group experienced more knee laxity, a higher rate of arthrofibrosis, and lower mean clinical outcome scores. The authors observed no difference in the rate of subsequent ACL injuries. The tibial eminence fracture group returned to sport sooner, but postoperative activity levels were similar for both groups[14].

A retrospective analysis of 41 adolescent patients treated operatively for acute patellar dislocation with associated osteochondral loose bodies (2010 to 2016) was performed to determine the rates of recurrent patellar instability when medial patellofemoral ligament reconstruction was not performed. Sixty-one percent of patients experienced recurrent instability at a mean follow-up of 4.1 years, and 39% required subsequent medial patellofemoral ligament reconstruction. A tibial tubercle-trochlear groove distance of >15 mm was a risk factor for recurrent instability[15].

Infection

The ideal test to detect septic arthritis is inexpensive and simple and has real-time results and a perfect negative predictive value. Mortazavi et al. conducted a prospective study to evaluate the performance of the leukocyte esterase strip test in the diagnosis of pediatric septic arthritis. Twenty-five children hospitalized for possible septic arthritis underwent arthrocentesis, and the aspirate was tested with the leukocyte esterase strip test, leukocyte count, and culture. The control group included 25 children undergoing surgical procedures for developmental dysplasia of the hip with synovial fluid similarly tested. The leukocyte esterase strip test was a valuable tool in the detection of septic arthritis, yielding a sensitivity of 100%, a specificity of 83%, and a negative predictive value of 100%[16]. Gram stain was found to be a poor screening tool for detecting septic arthritis and to be particularly ineffective for detecting gram-negative organisms. In a retrospective study of 302 children with septic arthritis of the hip, the sensitivity of the Gram stain for the detection of septic arthritis was 40% and the specificity was 97%[17].

A multicenter study was conducted to investigate risk factors for a repeat surgical procedure after the initial arthrotomy for septic arthritis of the hip. Fifty-six (41%) of 138 patients underwent repeat surgical debridement at a mean time of 5.5 days (range, 2 to 95 days) after the index procedure. Independent risk factors for a repeat surgical procedure included presenting C-reactive protein (CRP) of >10 mg/dL

What's New in Pediatric Orthopaedic Surgery

(p = 0.002) and erythrocyte sedimentation rate (ESR) of >40 mm/hr (p = 0.011). The odds of a repeat surgical intervention were significantly increased by the presence of osteomyelitis (odds ratio, 3.4; p = 0.001) and methicillin-resistant *Staphylococcus aureus* (MRSA)[18].

The use of the Kocher criteria in the diagnosis of septic arthritis of the hip is widely accepted. Whether these criteria can be applied to septic arthritis of the knee remains uncertain. A retrospective review was conducted for 104 patients who presented to a children's hospital with concern for septic arthritis of the knee. When the Kocher criteria were applied, 52% of septic knee cases could have been missed, indicating the need for further investigation of criteria specific to the knee[19].

Two recent studies investigated the effects of antibiotic timing on culture results and clinical outcomes in children with musculoskeletal infections. A retrospective study of 113 children with musculoskeletal infections found that tissue culture sensitivities were not decreased by antibiotic administration; however, earlier administration did correlate with shorter hospital stay for localized musculoskeletal infections[20]. Similarly, in a study of 131 patients with musculoskeletal infections, antibiotic administration before the surgical procedure did not decrease the surgical culture yield[21].

Limb Deformity

A retrospective study of 77 patients (131 physes) investigated the efficacy of the multiplier method to predict the time to lower-extremity angular correction. Predicted and actual time matched exactly in 15% of cases, and 69% of cases were underpredicted. Predictions were more accurate for genu varum than valgum and were within 3 months of the actual correction in 68%. The authors recommended adding 2 to 4 months to the predicted time if using this method for planning a hemiepiphysiodesis[22].

A retrospective study of 35 patients (47 physes) investigated the correlation between the initial screw angle (0° to 30°) and the mean rate of correction during hemiepiphysiodesis using tension-band plates and found no correlation. Anatomic landmarks for screw insertion rather than purposeful divergence are recommended when inserting screw-plate, tension-band devices[23].

Anterior hemiepiphysiodesis of the distal part of the femur to correct knee flexion contractures in patients with neuromuscular disorders was studied retrospectively. Knee flexion contractures improved compared with matched controls. Gait analysis showed improved knee flexion at contact and better range of motion with gait. Failed correction occurred in 12 knees, with increased age and posterior placement identified as risk factors for failure[24].

Epiphysiodesis is well established for the management of leg-length discrepancy in children. A retrospective study of 863 lower-extremity, uninstrumented epiphysiodeses showed that complications were infrequent (7% [60 patients]). There were 37 physeal-related complications, including angular deformity (n = 31) and overcorrection (n = 6). Complications were more common in younger patients, large limb-length inequalities, and congenital etiologies[25].

Hip

Two retrospective studies on development dysplasia of the hip originated from the Multi-center Pediatric Orthopedic Study Group of China. Fifty-one toddlers (64 hips) who were 24 to 36 months of age were treated with traction, closed reduction, adductor tenotomy, and casting. Of the 51 hips that met study inclusion, stable reduction was achieved in 39 hips (76.5%) and redislocation occurred in 12 hips (23.5%). Of the hips treated with closed reduction, 42.5% had residual acetabular dysplasia[26]. A second study reviewed 89 children (99 hips) treated with closed reduction at a mean age of 16 months. The acetabular index was the best predictor of persistent acetabular dysplasia after closed reduction. An additional surgical procedure after closed reduction was likely if the acetabular index was >28° at 1 year postoperatively or if it was >25° at 2 to 4 years postoperatively[27].

In a retrospective study, Maranho et al. compared 180 unilateral slipped capital femoral epiphysis cases with 70 cases that progressed to contralateral slipped capital femoral epiphysis to determine if the epiphyseal tubercle plays a role in this disease. The authors identified a metaphyseal lucency of the epiphyseal tubercle in 84% of patients with a contralateral slipped capital femoral epiphysis, with a specificity of 99%. The peritubercle lucency sign was noted on radiographs at a median of 9 weeks prior to diagnosis and, if this sign is noted in asymptomatic patients, magnetic resonance imaging (MRI) is recommended to detect a potential preslip[28].

The proximal femoral vascular supply was evaluated in patients with slipped capital femoral epiphysis (n = 17) compared with age and sex-matched controls (n = 17); the authors used delayed gadolinium-enhanced MRI of cartilage (dGEMRIC) focusing on blood flow to the posterosuperior aspects of the femoral neck. Of the hips with slipped capital femoral epiphysis, 5 unstable hips and 13 stable hips had a mean of 2 arteries, and control patients had a minimum of 4 arteries[29]. Patients with slipped capital femoral epiphysis may be more susceptible to procedures that jeopardize the lateral epiphyseal vascular supply.

Symptomatic femoroacetabular impingement in adolescent athletes can be successfully treated with hip arthroscopy. A retrospective review of a prospective database of patients who underwent hip arthroscopy at a single institution revealed 81 cases in 69 adolescent athletes with a 2-year follow-up. Sixty-one hips (75%) were in female patients, and labral repairs were performed in 82% of cases. Lesions with an Outerbridge grade of ≥2 more commonly involved the acetabulum (24%) than the femoral head (5%). Outcome scores were significantly improved at the 2-year follow-up, with 84% returning to sports and only 7% requiring a revision surgical procedure[30].

What's New in Pediatric Orthopaedic Surgery

Spine

A study of health-related quality of life after observation, bracing, or surgical management of adolescent idiopathic scoliosis was performed with a minimum 20-year follow-up in a cohort of 180 patients from a single center. In the observation cohort, 5 of 36 patients underwent a scoliosis surgical procedure as an adult. In the bracing cohort, only 1 of 41 patients required an additional spinal surgical procedure. In the surgical cohort, 7 of 103 patients required a revision surgical procedure as an adult. Fifteen patients (4 who had bracing, 7 who had fusion, and 4 who were observed) underwent a surgical procedure as an adult. No significant differences in patient-reported outcomes were found between bracing, a surgical procedure, and observation at a mean follow-up of 30 years[31].

A trend toward treating early-onset scoliosis with magnetically controlled growing rods instead of other methods has been documented over the last decade. The perceived advantages of avoiding a frequent return to the operating room and improved patient or family burden were studied through a multicenter, database of patients with early-onset scoliosis who underwent conversion from traditional growing rods to magnetically controlled growing rods. A total of 156 patients with traditional growing rods, 114 patients with magnetically controlled growing rods, and 32 patients with conversions (traditional growing rods to magnetically controlled growing rods) who completed at least 1 pre-treatment and 1 post-treatment EOSQ-24 (Early Onset Scoliosis 24-Item Questionnaire) were evaluated. No significant differences were observed in any EOSQ-24 domains between the converts and other 2 treatment groups. There was no significant postoperative improvement in patient or family burden or satisfaction in the magnetically controlled growing rod group[32].

Distal adding-on is a concern after posterior spinal fusion surgery for adolescent idiopathic scoliosis. Risk factors for distal adding-on in Lenke type-1B and 1C curves have not been well studied. A retrospective study of 46 patients with type-1B or 1C curves treated with posterior spinal fusion revealed distal adding-on in 11 patients (24%). A significant risk factor for distal adding-on was a lowest instrumented vertebra at or cranial to the last vertebra touched by the center sacral vertical line. In selective thoracic fusion, the lowest instrumented vertebra should be at or caudad to the last vertebra touched to avoid distal adding-on[33].

The risk factors for early deep surgical site infections (>3 months after the procedure) following a pediatric spinal deformity surgical procedure were studied retrospectively in 616 consecutive patients (2001 to 2016) at a single center. Surgical site infections developed in 11 patients. The independent risk factors included nonidiopathic scoliosis (neuromuscular, congenital, and syndromic) and the volume of crystalloid administered. The mean crystalloid administered (and standard deviation) was 3.3 ± 1.2 L in the surgical site infection group and 2.4 ± 1.0 L in the noninfected group ($p = 0.019$). There were no significant differences in patient weight or surgical time. Redosing antibiotics intraoperatively after 3 hours did not significantly influence the surgical site infection risk[34].

Missed Chance fractures can lead to a delay in treatment and poorer outcomes. In a retrospective review of patients treated at a tertiary level-I pediatric trauma center, 26 patients with flexion injury of the thoracolumbar spine were identified. Of these patients, 7 had a Chance fracture. Five (71%) of 7 Chance fractures were misdiagnosed initially: 3 as compression fractures, 1 as a burst fracture, and 1 as musculoskeletal pain. The mean delay to diagnosis was 95 days. A high index of suspicion is recommended for all thoracolumbar injuries to improve outcomes following the early treatment of Chance fractures[35].

Neuromuscular Disorders

Preoperative consultation with family before spinal fusion surgery for neuromuscular scoliosis is an important component. Eighteen families of children were interviewed with regard to important themes in decision-making and preparation for a surgical procedure. The families reported that surgeons should simplify the risks and benefits of the surgical procedure, a prolonged decision for a surgical procedure may not benefit the child, anxiety and fear occur over the decision for a surgical procedure, postoperative pain should be anticipated, recovery is long postoperatively, and family engagement and advocacy throughout the perioperative process are encouraged. This advice can help to shape information that surgeons convey to families preoperatively[36].

Sarcopenia following a botulinum toxin intramuscular injection has been observed in patients with cerebral palsy. A study of 11 patients with cerebral palsy who had injections to the gastrocnemius muscle found decreased muscle volume on MRI at 4, 13, and 25 weeks after the injection. A concomitant increase in volume of the soleus muscle occurred at the same intervals, with no increase in total plantar flexor volume. Considering that improvement in spasticity is short-term after botulinum toxin A injection and irreversible muscle loss occurs, routine repeated injections for children with spastic cerebral palsy should be reconsidered[37].

Rectus femoris transfer performed in patients with cerebral palsy for stiff-knee gait yields variable results partially because defined patient selection criteria are lacking. Sixteen children (20 limbs) with Gross Motor Function Classification System (GMFCS) level-I and/or II spastic cerebral palsy who underwent rectus femoris transfer for a stiff-knee gait and preoperative and postoperative 3-dimensional gait analyses were retrospectively evaluated. Two criteria were used: (1) a 1-parameter criterion of peak hip power, and (2) a 2-parameter criterion (peak hip power combined with when peak hip power occurred during the gait). When the 1-parameter criterion was used, 13 limbs met the criterion, and 11 had good outcomes. Seven limbs did not meet the criterion, and 6 of these had poor results ($p = 0.0049$). When the 2-parameter criterion was used, 11 limbs met the criterion, and all of them had good results. Nine limbs did not meet the criterion; 8 of the 9 limbs had poor

What's New in Pediatric Orthopaedic Surgery

results (p = 0.0002). Evaluating hip power and kinematics using gait analysis may help to predict when rectus femoris transfer will be successful[38].

Nonambulatory children are predisposed to hip subluxation or dislocation, but information with regard to when migration starts or progresses is lacking. An observational, prospective, multicenter cohort of 235 nonambulatory children who were 3 to 10 years of age and had GMFCS level IV or V were evaluated yearly with the Reimers hip migration percentage on radiographs. The prevalence of children with at least 1 hip with a Reimers hip migration percentage of >40% was 24.3%. Pelvic obliquity was observed in 51.4% of children with an asymmetric Reimers hip migration percentage and 24.4% of children with a symmetric Reimers hip migration percentage. Most children were assigned to the stable trajectory group, with a low prevalence of hip migration over time[39].

There are few data with regard to the treatment of the dislocated hip in infants with spastic cerebral palsy. A retrospective study of 11 patients (15 hips) who underwent surgical hip reconstruction in the setting of spastic cerebral palsy was performed at a single center. Preoperatively, the mean acetabular index was 29° (range, 19° to 46°). Patients underwent open reduction (15 hips), adductor tenotomy (14 hips), femoral osteotomy (10 hips), and pelvic osteotomy (12 hips). At a mean follow-up of 40 months postoperatively (range, 13 to 71 months), the mean migration index was 7% (range, −30% to 46%), and the mean acetabular index was 22° (range, 9° to 38°). No patients developed osteonecrosis. Open reduction with or without pelvic or femoral osteotomy had a nearly 90% success rate in achieving and maintaining hip reduction[40].

Foot

Clubfoot continues to be extensively studied. In the study by Zapata et al., 172 patients with clubfoot treated with either the Ponseti method (91 children) or the French physical therapy method (81 children) were followed prospectively and were tested for gross motor function at the age of 10 years using the Bruininks-Oseretsky Test of Motor Proficiency. The French functional physical therapy method resulted in better performance with running speed, body coordination, strength, and agility measures. The authors concluded that patients undergoing the Ponseti technique may benefit from supplemental components of the physical therapy method to improve gross motor outcomes[41].

Another study analyzed a prospective cohort of 42 patients (64 clubfeet) followed until the age of 5 years or to recurrence, defined as the need for more casting, bracing, or surgical procedures. Recurrence occurred in 26 feet (40%) and notably in 14 of 20 feet that required switching to an alternative foot abduction orthosis. The duration of casting was related to recurrence, and age, Dimeglio score, demographic characteristics, and subjective compliance were not[42].

The structural effects of long-term use of a medial arch support or insole for idiopathic flatfoot remain unclear. A prospective study compared 31 children (18 with orthotics and 13 controls) with idiopathic flexible flatfoot. At a mean 4-year follow-up, multiple radiographic parameters improved in both groups, but all still remained outside of the normal range. There were no significant differences between the 2 groups[43].

A variety of options are available for interposition during calcaneonavicular coalition resection. Three institutions retrospectively compared 56 feet (48 patients) treated with interpositions of fat graft (23 feet), bone wax (18 feet), and extensor digitorum brevis (15 feet). The extensor digitorum brevis group had significantly more pain, lower American Orthopaedic Foot & Ankle Society (AOFAS) scores, and more regrowth of the coalition. All 5 symptomatic recurrences occurred in the extensor digitorum brevis group[44].

Evidence-Based Orthopaedics

The editorial staff of JBJS 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 cited already in this update, 10 other articles relevant to pediatric orthopaedic surgery are appended to this review after the standard bibliography, with a brief commentary about each article to help guide your further reading, in an evidence-based fashion, in this subspecialty area.

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What's New in Pediatric Orthopaedic Surgery

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What's New in Pediatric Orthopaedic Surgery

Evidence-Based Orthopaedics

Amirmudin NA, Lavelle G, Theologis T, Thompson N, Ryan JM. Multilevel surgery for children with cerebral palsy: a meta-analysis. *Pediatrics.* 2019 Apr; 143(4):e20183390.

The objective of this study was to summarize the literature examining the effects of and satisfaction with multilevel surgical procedures for children with cerebral palsy. Seventy-four studies (1 randomized control trial [RCT] and 73 cohort studies) were identified from the data sources. Two authors screened and extracted data on gross motor function, gait speed, range of motion, strength, spasticity, participation, quality of life, satisfaction, and adverse events. Findings revealed that gait, but not gross motor function, improved after multilevel surgical procedures. Participation and quality of life were reported in only 5 studies, and adverse events were reported in 17 studies. Data were largely from cohort studies, indicating a need for RCTs.

Gelfer Y, Wientroub S, Hughes K, Fontalis A, Eastwood DM. Congenital talipes equinovarus: a systematic review of relapse as a primary outcome of the Ponseti method. *Bone Joint J.* 2019 Jun;101-B(6):639-45.

A prospectively registered systematic review was performed to determine the outcome of the Ponseti method with respect to assessment at presentation, correction, and relapse. A total of 84 studies were included (7,335 patients and 10,535 clubfeet). The Pirani scoring was the most common method used to determine relapse, although only 57% of the studies defined relapse and there was high variability in the assessment methods used. The rate of recurrence and need for further surgical intervention (major surgical procedures, 1.4% to 53.3%; and minor surgical procedures, 0.6% to 48.8%) in idiopathic clubfoot increased with the duration of follow-up. These results suggest that the corrected and relapsed foot is poorly defined, and a better definition of relapse is needed.

Iyer S, Boachie-Adjei O, Duah HO, Yankey KP, Mahmud R, Wulff I, Tutu HO, Akoto H; FOCOS Spine Research Group. Halo gravity traction can mitigate preoperative risk factors and early surgical complications in complex spine deformity. *Spine.* 2019 May 1;44(9):629-36.

To examine the role of preoperative halo gravity traction in reducing surgical risk, a retrospective study of 96 patients was conducted. The FOCOS (Foundation of Orthopedics and Complex Spine) Score was used to quantify operative risk. The FOCOS Score was calculated using patient factors (American Spinal Injury Association [ASIA] score, BMI, etiology), procedure factors (osteotomy planned and number of levels fused), and curve magnitude. Scores ranged from 0 to 100, with higher scores indicating increased risk. When the FOCOS Score was unable to be lowered by ≥10 points, patients were 5 times more likely to have a complication. The authors concluded that preoperative halo gravity traction can reduce the FOCOS Score and surgical risk by improving curve magnitude and lowering the need for 3-column osteotomies. Halo-related complications occurred in 34% of patients, but revision was required in only 8.3%.

Kim DH, Kim N, Lee JH, Jo M, Choi YS. Efficacy of preemptive analgesia on acute postoperative pain in children undergoing major orthopaedic surgery of the lower extremities. *J Pain Res.* 2018 Sep 26;11:2061-70.

The ideal postoperative pain management strategy in children remains unknown. The effect of an intraoperative epidural infusion of local anesthesia on postoperative pain and analgesic requirements was tested in 23 patients compared with a control group. Pain scores were lower in the epidural group at 30 minutes and 6 hours postoperatively; however, they were not significantly different at 12, 24, or 48 hours postoperatively. The authors concluded that intraoperative epidural did not demonstrate preemptive analgesic efficacy in children undergoing lower-extremity orthopaedic surgery.

Lee DY, Park YJ, Song SY, Hwang SC, Park JS, Kang DG. Which technique is better for treating patellar dislocation? A systematic review and meta-analysis. *Arthroscopy.* 2018 Nov;34(11):3082-93.

The authors searched the MEDLINE, Embase, Cochrane Central Register of Controlled Trials, Web of Science, and Scopus electronic databases for relevant articles published before August 2017. They compared the outcomes of medial patellofemoral ligament reconstruction to evaluate which technique yields better improvement in stability and functional recovery for patellar dislocation. There were a total of 11 clinical studies investigated. Following primary patellar dislocation, there were no significant differences in outcomes between the conservative and surgical treatment groups. In patients with recurrent patellar dislocations, medial patellofemoral ligament reconstruction was associated with more favorable clinical outcomes compared with medial soft-tissue realignment surgical procedures.

Lee SH, Yun SJ. Diagnostic performance of ultrasonography for detection of pediatric elbow fracture: a meta-analysis. *Ann Emerg Med.* 2019 Oct;74(4): 493-502. Epub 2019 May 9.

The authors searched the PubMed and Embase databases for diagnostic accuracy studies that used ultrasonography to detect an elbow fracture in pediatric patients with trauma and identified 10 articles (519 patients) to be included in their study. With a false-negative rate of only 3.7%, elbow ultrasonography demonstrated high performance in diagnosing pediatric elbow fractures. Ultrasound performed by trained physicians may be considered as a first-line diagnostic tool to diagnose pediatric elbow fractures.

Makarov MR, Jackson TJ, Smith CM, Jo CH, Birch JG. Timing of epiphysiodesis to correct leg-length discrepancy: a comparison of prediction methods. *J Bone Joint Surg Am.* 2018 Jul 18;100(14):1217-22.

The authors followed 77 patients treated with epiphysiodesis to skeletal maturity to compare the accuracy of different methods used to predict ultimate leg lengths and residual leg-length discrepancy. Using the White-Menelaus, Anderson-Green, Moseley, and multiplier methods, the predicted lengths of both legs and residual leg-length discrepancy at maturity were compared with actual outcomes. The prediction accuracy of each method was improved by using skeletal age, rather than chronological age. The multiplier method was the least accurate of the prediction methods in this patient population. The mean prediction error of the length of the short leg varied from 1.8 ± 1.2 cm for the straight-line graph to 2.5 ± 2.0 cm for the multiplier method, and that for the long leg after epiphysiodesis varied from 1.2 ± 1.1 cm for the straight-line graph to 1.7 ± 1.5 cm for the multiplier method.

Ovadia D. Drexler M, Kramer M, Herman A, Lebel DE. Closed wound subfascial suction drainage in posterior fusion surgery for adolescent idiopathic scoliosis: a prospective randomized control study. *Spine (Phila Pa 1976).* 2019 Mar 15;44(6):377-83.

A prospective randomized controlled study was conducted to compare the complication rate in adolescent idiopathic scoliosis posterior spinal fusion surgical procedures with and without drainage. One hundred patients with adolescent idiopathic scoliosis undergoing instrumented posterior spinal fusion surgical procedures were blindly randomized to a deep drain group (n = 48) or a no-drain group (n = 52). The collected data included wound findings, hemoglobin, hematocrit, and fever. The mean follow-up was 20 months. Complications in the no-drain group included 1 case (1.9%) of pneumonia, 2 cases (3.8%) of wound dehiscence, and 2 cases (3.8%) of superficial wound infection. There was 1 wound dehiscence in the deep drain group. There were no deep infections in either group. The authors concluded that there is no advantage to deep drainage in patients with adolescent idiopathic scoliosis undergoing posterior spinal fusion surgical procedures, as wound complications were low and identical for both groups.

Selhorst M, Rice W, Jackowski M, Degenhart T, Coffman S. Sequential cognitive and physical approach (SCOPA) for patellofemoral pain: a randomized controlled trial in adolescent patients. *Clin Rehabil.* 2018 Dec;32(12): 1624-35. Epub 2018 Jul 26.

What's New in Pediatric Orthopaedic Surgery

A randomized, controlled study of 55 adolescents was performed to compare a sequential treatment algorithm considering psychosocial and physical impairments (sequential cognitive and physical approach [SCOPA]) with a conventional rehabilitation approach considering only physical impairments in adolescents with patellofemoral pain. At baseline, both groups had similar function and pain. Patients randomized to the SCOPA group had clinically important greater improvements in function at 6 weeks. At 6 months, both groups demonstrated similar clinically important improvements in all outcomes.

Yoshihara H. Surgical treatment of Lenke type 5 adolescent idiopathic scoliosis: a systematic review. *Spine (Phila Pa 1976)*. 2019 Jul 1;44(13):E788-99.

The authors queried PubMed, Embase, and Web of Science through August 2018 for articles on the surgical treatment of Lenke type-5 adolescent idiopathic scoliosis. There were 50 studies that met the inclusion criteria. The range of the mean number of levels fused for anterior procedures was 3.6 to 5.3, and the percentage of corrections of the thoracolumbar and lumbar curve at the final follow-up was 53% to 86%. The range of the mean number of levels fused for posterior procedures was 4.3 to 7.8, and the percentage of correction of the thoracolumbar and lumbar curve at the final follow-up was 55% to 94%. The thoracic curve spontaneously corrected after the surgical procedure in both groups. The preoperative coronal imbalance was resolved (<20 mm) in all 37 reporting studies at the final follow-up. The Scoliosis Research Society 22-Item Questionnaire (SRS-22) scores showed no difference between anterior and posterior procedures in most of the reporting studies.