



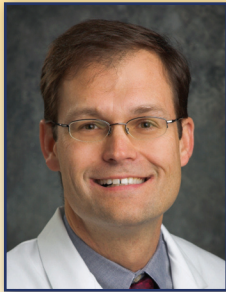
September 2013

Resident *Review*

Cutting Edge Orthopaedic Information Enhancing Resident Education

Who gets the knife?

By Steven L. Frick, MD, Editor



Steven L. Frick, MD

"First I will get ready, and then perhaps my chance will come."
– John Wooden

At scrub sinks and OR tables all over the country this summer, surgical cases are starting and both resident and attending hands are being held out for scalpels. Who will get the knife? This question is being pondered and

hopefully discussed by many orthopaedic residents and attending surgeons. Summertime brings an academic new year, and with it PGY1 residents become full-time orthopaedic surgeons, and junior residents become senior residents. These transitions bring expectations on the part of these residents (and their program directors) that they will have increasing involvement in surgical cases.

So how does this decision get made? There are some residents who feel as if they should always get the knife, even if they have not done the preparatory work to deserve it. And conversely, there are some attendings who will not give up the knife, even to deserving residents. Neither of these situations is desirable- residents who expect to be handed the knife just because they show up, and who complain and pout rather than learn to be a good assistant, can be poisonous to the morale of a residency program. Attendings who never allow residents to perform the difficult parts of cases do the residents in their program a disservice, give the program a bad reputation, and fail to fulfill their societal obligation to pass on their knowledge and skills to the next generation.

Here is a "top-ten" list I consider before giving the knife to the resident to perform the technical parts of a surgical procedure. If you are a resident helping me in the OR today, if you can answer these questions it is likely you will be doing the case.

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Technology Corner: POSNA Educational Resources Review

By Orrin Franko, MD

As November approaches, many residents may wonder how their mobile devices can help prepare them for the in-training exam. This column will provide tips and tricks for utilizing your phone or tablet to study for the OITE.


First and foremost, your tablet (iPad, iPad mini, Android, Surface, etc.) is a traveling library. There is now a vast selection of useful tools to manage, read, and even annotate or highlight PDFs. Some of the most popular apps include iAnnotate and GoodReader, and both include the ability to save annotated PDFs, share them with colleagues, and sync fluidly with DropBox and many other cloud-based servers. An argument can be made that typically journals and textbooks are not delivered in full-text PDF form, thus making the extra steps somewhat cumbersome for transferring documents onto your iPad or other device. Try this little trick to simplify the steps:

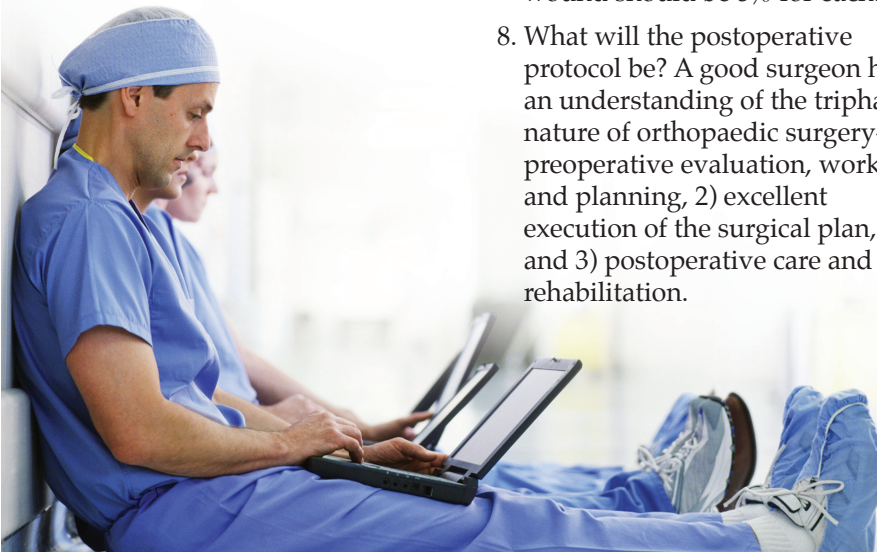
1. Create a DropBox account (free) and add a folder to your computer desktop called "Journal Articles." This will automatically sync the contents of that folder with your DropBox.
2. Utilizing iAnnotate or GoodReader, allow access to your DropBox account and set the app to automatically sync with your new "Journal Articles" folder.
3. Google Chrome web browser allows you to view and save PDF files directly from the browsing window, without having to open Adobe Reader. When you find an interesting article online, save it directly to the "Journal Articles" folder on your desktop.
4. These three steps take about 10 minutes to set up and saving PDF articles takes about 5 seconds. Now your tablet will always have the most updated PDFs that you have selected for mobile viewing.

** An additional tip: many new textbooks include a code for "online access." While most of these sites do

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1. Who gets the knife? This time the question is from the perspective of the patient- in other words, what are the indications for surgery? Why are we in the operating room today? What are the risks and benefits of today's surgical procedure? While a discussion of the alternatives should not be held on the day of the operation, the resident should know what they are.
2. What is under the skin incision? Have a good knowledge of the anatomy of the region, especially the nerves and arteries in the region of the approach. Understand the approach and the anatomic intervals that will be used to "get to the bone."
3. What is the plan? Have a preoperative plan for how you are going to accomplish today's surgery. Having the wrong plan won't keep you from getting the knife in my room, but having no plan likely will. The plan should consider what equipment will be needed, what imaging should be available, any medical or anesthetic considerations, how to position the patient, and the type and placement of implants.
4. What is "plan B?" Having a backup plan in mind, especially for fracture and reconstruction cases, is evidence of a prepared surgeon.
5. What constitutes good soft tissue handling technique? How do technically excellent surgeons move from skin to bone, efficiently and with minimal blood loss and soft tissue injury? The ability to get good exposure and visualization is critical in technically excellent surgery- how to use retractors effectively and proper involvement of surgical assistants is very important.
6. What are the hard tissue maneuvers to consider? Will this be fracture surgery where exposure of the fracture fragments while preserving soft tissues, followed by anatomic reduction, is important, or is it an osteotomy with realignment of major fragments? The ability of the resident to appreciate the three dimensional nature of many of our surgeries, and adjust as needed, is critical. Get to bone and stay there is a tried and true maxim in orthopaedics- place retractors to protect the soft tissues, then do good carpentry.
7. How are you at closing the wound? A resident who cannot efficiently close a wound, with good soft tissue technique and cosmesis, is not likely to get the knife on the next case of the day. If you are slow, practice and become efficient. One of my mentors used to say surgical time for opening and closing the wound should be 5% for each.
8. What will the postoperative protocol be? A good surgeon has an understanding of the triphasic nature of orthopaedic surgery- 1) preoperative evaluation, workup and planning, 2) excellent execution of the surgical plan, and 3) postoperative care and rehabilitation.
9. What will we be worried about just after the surgery? Good surgeons see their patients whenever possible in the recovery room and early the day after surgery. If I don't see you doing postop checks to document intact function distal to the surgery site, or if I beat you to the patient frequently for rounds, I will question your commitment and be less likely to give you the knife next time.
10. What are the expected results from today's surgery? What does the literature say about this procedure for this diagnosis? Residents should be familiar with what is written in our literature about the outcomes of the procedure, and be knowledgeable about the strength of the evidence.

Our system of educating surgeons still largely follows Halstedian principles, and one of the most critical is the concept of graduated responsibility (residents assuming more and more responsibility as time passes during residency, which in surgical specialties means residents actually doing more and more of the surgical procedures). Accomplishing this over the five-year period of residency requires work on the part of both residents and attendings. Above is my list of prerequisites for residents to get "playing time" in the OR- bring it up with your attending and see what their list looks like- and if you want the "get the knife," then get ready. As another of my mentors Dick Gross has written- "Surgery is too important to leave to the unprepared." 



Interview with Peter Newton, MD: *Immediate Past President of POSNA*

By Brian Scannell, MD

1. In your year as POSNA president, what issue or issues did you have to deal with that were the most important?

I came to the presidential line from the perspective of a past treasurer of POSNA and so the “no money, no mission” motto had special meaning. I wanted to be absolutely certain the board had mechanisms in place to know and understand the financial position of the organization. Philanthropy is an important personal goal for Cathy and me; as such I hoped to create meaning for the donations made by our members. One of the important additions in my view this past year was the expanded donations and financial commitment that were focused on research. There are now 10 grants per year, each with up to \$30,000 in funding as well as a newly launched \$100,000 grant available to improve the quality and safety of pediatric orthopedic clinical care. The other very important task centered on reinforcing the relationships we have with our global pediatric orthopedic society partners. I am very happy that along with the POSNA office staff, Peter Waters and I were able to nail down the details with our colleagues at EPOS for a combined meeting of our 2 societies in 2017 (Barcelona). We are also partnering in Asia and South America on educational meeting in the months and years ahead.

2. How do you prioritize and balance your many roles (surgeon, researcher, consultant, administrator, POSNA president, family man, etc)?

Balance is something I achieve more often in my patients’ spine than in my own life, but I’m working on getting balance in both 100% of the time. I do my best to make sure the things I do, I love to do. This doesn’t mean these roles don’t compete and for sure there is a priority that puts some in front of others. Trying to define the time for each role helps and not unlike the sock drawer, when new ones come in, old ones have to go. I think you have to expect the roles and jobs to evolve as you evolve through your career; getting them to all balance all the time is tough. Keep the things nearest and dearest to you at the top of the pile.

“...I’m working on getting balance in both 100% of the time. I do my best to make sure the things I do, I love to do.”

3. Follow up question = Do you sleep?

Unfortunately the day only has 24 hours and no matter how you slice it, sleep takes its piece of the daily pie. I wish I could survive on less and occasionally I pretend I’m one of those folks that only needs 4-5 hours a night. I’m OK like that for short stents, but I always have to pay back the “sleep bank,” often with interest. Sunday afternoon is when I get caught up.



Peter O. Newton, MD.

4. What do you do for fun?

If you do it right, it’s all fun! Seeing patients back after they are healed and on with their life is fun. Fixing a spine in the OR is fun. Yucking it up with my POSNA presidential line buddies hoping to give the society direction is fun. Discovering and sharing what the future holds for scoliosis care is fun. It’s (mostly) all fun. Outside of work I enjoy projects around the yard and in the garage. My son Walker and I have been working on restoring a Triumph Spitfire. It has been a great project that goes in fits and spurts based on my travel and his homework, but we have a running sports car that we are both proud of (even if we can’t get it to pass CA smog standards...). I try to get some time to myself with a weekend walk/jog/hike. I rerun some of the week’s events, think big, think small and generally let my mind go where it wants. Sometimes I come home with a to-do list for the week and sometimes I just come back tired. At some point I’d like to become a good enough surfer that I could accomplish this

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on the water as well, but at this point I'm too preoccupied with the task of standing up to get any thinking done. Fishing is the other activity I will always say yes to, flies on a stream or trolling in the Pacific.

5. How did you first become involved in POSNA early in your career?

I don't actually recall. POSNA has been a part of my professional life as long as I can remember. I'm sure I started out by submitting papers to the annual meeting. One year the program committee accepted one. Eventually I was on the program committee. I'd say in looking back that I got involved from the scientific side of POSNA, but there are many sides to POSNA for members to become involved. The council structure of the organization gives some insight to how POSNA organizes itself and prioritizes its activities: Education, Research, Communication, Health Care Delivery, Treasurer's, Secretary's and President's. There are over 35 committees and 300+ positions available each year for members to volunteer, and volunteer they do. Unfortunately there are always more members interested than positions available. If you are looking to participate, keep volunteering and don't be discouraged. The AAOS and the AAP, Section on Orthopedics also have opportunities to get involved in a professional society.

6. Who were some of the people that influenced you to pursue an active role within POSNA?

My mentors at many levels helped me see and understand the importance of research and education in addition to clinical practice, and these same folks both from residency, fellowship

and when I started practice all offered encouragement academically. Developing and maintaining relationships with mentors is something we all need, no matter where in our career we are. Given what POSNA is and does, I didn't need much encouragement to get involved. I have always found my involvement to create a great sense of honor and pride.

7. In your training what drove you towards more of a spine practice?

I was intrigued by scoliosis after seeing my first CD (Cotrel Dubousset) instrumentation as a resident. Deformity correction is at the heart of pediatric orthopedics, and I was sold on it both from the extremity and spinal side. When I started in practice, Ilizarov limb deformity correction and scoliosis correction were evolving fields that I jumped into. With time, my experience with thoracoscopic spinal surgery drew me deeper into scoliosis. My research went that way as well, and one thing led to another. Now the OR folks ask if I still have privileges when I try to operate on a leg. By the way, I do.

“Developing and maintaining relationships with mentors is something we all need...”

8. Of your research contributions, which is the most significant to you? Why?

I hope my most significant contribution is still to come... For now I think the work our research group has done on growth

modulation in the spine has the greatest potential to change scoliosis care. The potential to correct scoliosis without a fusion procedure is very exciting to me, and I think we may see that as truly possible in the near future. Having said that we are doing much better with our fusion surgery and working with the Harms Study Group has been extremely valuable for me as a surgeon. The collaboration of peers around the globe has resulted in many great ideas on how to analyze and improve what we do as scoliosis surgeons. Working with a team is almost always better than working as an individual.

9. What will scoliosis treatment be like in 10 years?

I can envision very different scoliosis treatment 10 years from now, but the biggest changes will require an understanding of the etiology. Knowing AIS is a genetic condition gives me hope that with the rapidly advancing field of genomics that we will soon understand the pathways that lead to altered spinal growth of so many teens. Understanding the physiology opens the possibilities to medical treatments in a world where only mechanical solutions exist today. As much as I'd like to think that 10 years is a long enough time for such discovery, it likely is not. As such we will likely remain in the mechanical world of scoliosis correction for much longer. I would hope that in 10 years the fusionless growth modulation options of treatment are understood well enough and effective enough to become commonplace. I also believe the 3 dimensional imaging and assessment of scoliosis will be far enough along that the selection of fusion levels and

correction strategies will be more standardized. It is very clear to me that we have far too much art and not enough science in how we as a community of surgeons treat scoliosis at this time. The screws, hooks, rods and tools to do the work are similar, but the actual methods each surgeon uses to apply them vary widely. Early onset scoliosis is another unsolved problem, with lots of room for improvement and discovery. I believe the variation will be less and the quality greater 10 years from now in both EOS and AIS.

10. Do you believe bracing for AIS works? If so, in which patients?

Yes bracing works! We just don't know how to choose the right patient to brace. For many we now brace with standard indications (Cobb 25-45, Risser <2), about half don't progress because they weren't going to. There is another quarter of the patients who are braced that progress despite the brace. Skipping the brace for those that won't progress without it as well as those that will progress despite it is what we need for brace treatment to improve. Treating 4 to help 1 suggests much room for improvement; I just can't pick them out the one at this point.

11. With all of the specialization happening in Peds Ortho, where do you envision the fellowship process going?

I do think subspecialization in Peds Ortho is here to stay. The fields are advancing too fast in too many directions for a single pediatric orthopedic surgeon to be proficient in everything. The choice of knowing/practicing "almost nothing about everything" or "everything about almost nothing" plagues

us all. Where do you want to be on that spectrum? The bigger the community and practice the more likely subspecialization makes sense. It also seems the younger the surgeon the more likely the tendency towards subspecialization.

12. Are there going to be Peds Spine,

“Treating 4 to help 1 suggests much room for improvement...”

Peds Hip, Peds Hand, Peds Sports fellowships?

The mechanisms for folks to get specialized training will likely vary and some pediatric subspecialty fellowships will and do exist. Are these enough to get the rest of the Peds Ortho general training required to function in a Peds Ortho group where call needs to be covered? In our practice we have had folks do additional subspecialty training after completing their Peds Ortho fellowship, as well as folks join our group after completing a more traditional specialty fellowship (spine, sports). The second path involves on the job general Peds Ortho training, particularly for trauma and infection care that is typical of a night on call at our center. I think either path can work.

13. Are people going to have to do 2 fellowships?

There is certainly an increasing trend in applicants planning on two fellowships. I don't think two fellowships will be required, although those coming through the Peds Ortho fellowship first path are likely to want more training in spine, sports, hand

and possibly hip as the years go, depending on the strengths of their initial fellowship. The first several years of practice should be considered a "fellowship" with your senior partners helping. Please don't think you are supposed to have learned it all by the last day of fellowship, no matter how many you do. With that definition we all do at least 2 fellowships.

14. In regards to fellowship training, what is best for the trainees but also best for the community and patients?

What is best for everyone is finding the right mix of "generalist" and "subspecialist" for the specific community. There is room for a subspecialist in the big city, and a need for the generalist in both big and small cities.

15. Is there still a role for the general pediatric orthopedic surgeon?

As implied above, absolutely! It is unlikely there will be a fellowship in muscular dystrophy, osteogenesis imperfecta, or Morquio's. Who is going to understand these conditions if we completely subdivide the pediatric patents into their anatomic parts? The generalist/subspecialist dilemma that faces pediatric orthopedics is very similar to that which faces orthopedics and medicine in general. We need both.

16. Do you think we will eventually have CAQs for pediatric orthopaedics and for pediatric ortho subspecialties like spine deformity?

I think this is unlikely in the near to mid-term. There are pros and cons to the certificate of special qualification pathway, and the gain in quality (real or perceived)

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is of course the goal. There are a number of methods to maintain quality in our specialty training, and POSNA remains committed to helping attain the highest quality in pediatric orthopedic training with or without a CAQ.

17. Do we need more pediatric ortho fellowships, or do we have enough?

The fellowship seekers will determine if we have enough fellowships. I think the market adjusts pretty well and I suspect we are about right.

18. How is pediatric orthopaedics in North America different from how it is practiced abroad?

In the developed countries I'd say it's pretty similar, taking into account the differences in how health care is generally administered. We all think we see

too many patients with intoeing. Get to the developing countries and the differences are striking. The disparities that exist around the globe in pediatric orthopedic care are vast. Traveling the world to experience the lives of your peers is one of the "haves." Take advantage of the opportunities to travel. Attend one of POSNA's global partners meeting (EPOS - Europe, SLAOTI - South America, APOA - Asia Pacific) to experience the similarities and the differences, but more importantly meet a colleague on the other side of an ocean. Travel to an underserved region and really get a dose of reality.

19. What is the role of midlevel providers in pediatric orthopaedics?

Mid level providers are clearly

going to have a bigger role in medicine and this extends to our specialty as well. Given we are surgical specialty and the midlevel providers are not surgeons, there is great potential to have MLP fill many of the non-operative roles. Our group of 10 is currently outnumbered by MLPs who help us manage the non-surgical side of the business. Common nonoperative problems, as well as nonoperative trauma care, are where we currently focus our MLPs efforts. The potential roles are many and will vary depending on the experience of the individual and the needs of the practice. These folks are very important to our field and I am glad they now have an opportunity to become members of POSNA. ▬

Technology Corner: POSNA Educational Resources Review (from page 1)

not directly permit book chapters to be saved as PDF, they typically allow you to "print" a chapter. Google Chrome browser also allows you to "print" directly to PDF, thus allowing for a 1-step solution to transfer your online textbooks subscriptions to your tablet.

Many residents utilize the AAOS Orthopaedic Knowledge Update v10 to assist with OITE and board study, but the books lack a supplementary question bank. Thankfully, the California Orthopaedic Association has developed their own QBank based directly from the book text and have made it available to residents for only \$40 for COA resident members

(\$70 for non-member residents). The flashcards are available through Quizlet, an online flashcard database that allows you to sync the data with any of at least 30 flashcard apps (typically free or less than \$2). To sign up for this unique and useful service, visit this link: <http://fs17.formsite.com/COAA/flashcards/index.html> or learn more at www.coa.org.

Most, if not all, residents are familiar with OrthoBullets as a free and comprehensive question bank with review facts, images, questions, and answers. However, you may not know that the site has a mobile version for "on the go" test preparation. Admittedly the site

is somewhat primitive by current standards, but it contains all of the same useful features found on the full site: fact review, images with descriptions, in-text cross-referencing to images and questions, and full QBank tests with answers (either testing or VEQTR learning mode). Many residents may find this useful during down time in or out of the hospital.

I hope you find these suggestions useful for your OITE and board preparation. Good luck! ▬

Interview With Randall Loder, MD: *Management Of Slipped Capital Femoral Epiphysis At Riley Children’s Hospital, Indianapolis*

By Christine Caltoun, MD

1. What is the definition of an unstable slipped capital femoral epiphysis?

Inability to walk with or without crutches.

2. Do you consider this a surgical emergency?

Yes.

3. How many hours do you consider it “safe” to wait before going to the OR?

There is no good objective data on this subject. The patient should be treated within 24 hours if possible. I would not compromise NPO status to take to OR but would ideally like to get the patient to the operating room ASAP.

4. What is your surgical treatment algorithm?

1) Gentle repositioning of the limb on the fracture table.

2) Fixation of the SCFE with 2 screws (Dr Loder uses 6.5 mm cannulated screws).

3) Hip joint decompression through instrumentation incision, documented fluoroscopically with the use of a Cobb or large Kelly clamp.

5. What is your post-operative regimen?


6 weeks non-weight bearing on the affected limb, followed by protected weight bearing if callous visible at 6 week mark, return to activities at 3 months.

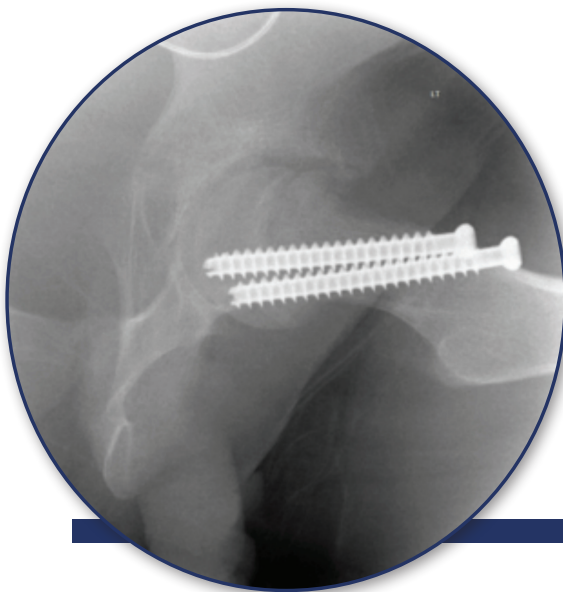
6. Do you routinely take out SCFE implants?

No. SCFE implants are not routinely removed. The screws are only removed in cases of AVN when the tip of the screw may become intra-articular as the bone collapses.

Comments by Dr Caltoun: Classic study by Dr. Loder demonstrated a 47% AVN rate when calculated with a 2 year follow-up. Most patients who went on to AVN did so within the first 3-4 months post-injury. If the AVN rate was calculated at 1-year follow-up when there was a larger cohort of patients (to include those doing well that had not been lost to follow-up), the AVN rate was closer to 30%. The complication that Dr. Loder seeks to avoid is avascular necrosis as he feels that other problems such as impingement can be treated while AVN cannot. When asked specifically, Dr. Loder’s impression, while not backed by



clinical evidence, is that patients treated for unstable slips do well as long as they do not go on to AVN. A very small percentage of his patients have required second procedures. Following are preoperative, intraoperative, and postoperative images of a typical unstable SCFE patient. 



Interview With David Podeszwa, MD: Treatment Of Unstable Slipped Capital Femoral Epiphysis At Texas Scottish Rite Hospital For Children

By Anthony Riccio, MD

1. What do you see is the role for surgical dislocation of the hip in the management of the unstable slipped capital femoral epiphysis?

The exact indication for an open reduction of an unstable SCFE has not been fully established. Several questions still need to be answered: Who is the ideal candidate? What is the rate of AVN? When should the procedure be performed? Who should be performing the procedure?

There is still no definitive data available which provides the rate of AVN from an open reduction of an unstable SCFE. There have been relatively small retrospective studies of the open reduction but we still lack the experience we have with in-situ pinning.

A severely displaced slipped capital femoral epiphysis, if pinned in-situ, can result in significant residual deformity and significantly restricted motion and/or femoral acetabular impingement. We know that, with time, the severe slipped capital femoral epiphysis will develop labral and articular cartilage injury. Therefore, the theoretical role open reduction is restoration of anatomic or near anatomic alignment, maintenance of range of motion and prevention or limitation of intra-articular damage.

2. When an unstable SCFE comes into Texas Scottish Rite Hospital, how is it treated?

Confirming the diagnosis is the first step. The diagnosis of an unstable slip is based

on the Loder Classification. If the patient does not have the ability to bear weight, then we consider that slip unstable. These kids usually present in a very typical manner, with some prodromic pain, whether for a few days, a few weeks or even a few months. Then there is an episode that results in severe pain and the inability to bear weight. We then confirm that we have appropriate imaging - an AP pelvis x-ray and a lateral of the contralateral hip. These patients are kept on bed rest. We treat them urgently, as you would an open fracture. If we have the opportunity to treat them right away, we will. However, if it is two or three o'clock in the morning, we will wait until we have the appropriate facilities and appropriate team together the following morning.

“Is there a higher AVN rate in open reduction versus insitu pinning?”

If we perform an in-situ pinning, there is no reduction maneuver performed. The patient is placed on the fracture table and the reduction we obtain from positioning is what we accept. They undergo in-situ pinning with two fully-threaded 6.5 mm cannulated screws and some form of a capsulotomy. Whether it's a formal capsulotomy, an aspiration of the hip or using a hemostat to open the capsule, it's surgeon preference.

If an open reduction is performed, it is performed using the Modified Dunn technique described by Leunig and Ganz. Reduction is typically performed while monitoring the blood flow to the femoral epiphysis using an intra-cranial pressure monitor. Fixation of the femoral epiphysis is performed using two 6.5 mm fully threaded cannulated screws. The failure of fixation in a patient early in our experience was with 4.5 mm cannulated screws. Post-operatively, the patient remains foot flat weight bearing for 3 months.

3. You and Dan Sucato are currently conducting a prospective randomized trial on unstable slips. Could you tell us a little bit about your research?

Several years ago, we started a randomized trial to answer the question: “Is there a higher AVN rate in open reduction versus insitu pinning?” When a patient presents to our emergency department with an unstable slip, either Dr. Sucato or I discuss the study and risk/benefits of both procedures with the family and ask them to participate. If they agree, we open an envelope which randomly tells us whether we are going to perform an in-situ pinning or an open reduction. If the family chooses not to participate, then each procedure is discussed again and the family decides which procedure will be performed. Whether the family chooses to participate or not, there is no change in the timing of surgery or how it is performed.

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Challenging Cases: Pediatric Musculoskeletal Trauma

Question 1

P.J. is a 7yo female who injured her right tibia in a horseriding accident. She was noted to have an isolated closed distal tibial shaft fracture, an intact fibula, and 5 degrees of varus angulation. She was admitted overnight for observation for a compartment syndrome. She did well overnight with minimal pain, and underwent fracture stabilization the next day. Which option represents the preferred management for the aforementioned fracture?

- A. Long leg cast application, followup in 4-6 weeks
- B. Long leg cast application, followup in 1-2 weeks
- C. Open reduction and internal fixation with a compression plate and screw construct
- D. External fixation

Preferred Response: B

Discussion: The patient has a distal tibial shaft fracture with an intact fibula. The amount of fracture angulation on presentation is acceptable, however, these fractures have a propensity to fall into varus and recurvatum despite cast immobilization. Yang and Letts reported on 95 isolated tibia fractures with an intact fibula. Out of 76 patients with initial fracture angulation, 61% had varus angulation, 25% had recurvatum, 8% had valgus, and 7% had procurvatum. They theorized that the propensity to varus was due to the splinting effect of the intact fibula as well as the varus force produced by the posterior tibialis muscle and toe flexor and extensors. 32 of the 76 patients (42%) had some recurrence of the deformity even after closed reduction and casting. All recurrences involved varus and/or

recurvatum; no loss of reduction was noted in the valgus or procurvatum groups. The vast majority of children with isolated uncomplicated tibia fractures can be managed in a closed fashion. External fixation is reserved situations with extensive comminution, multitrauma, or severe soft tissue compromise. ORIF is associated with wound problems and is rarely indicated in children.

References:

1. Yang JP, Letts RM: Isolated fractures of the tibia with intact fibula in children: a review of 95 patients. *J Pediatr Orthop* 1997; 17(3): 347-351.
2. Mashru RP, Herman MJ, Pizzutillo PD: Tibial shaft fractures in children and adolescents. *J Am Acad Orthop Surg.* 2005; 13(5): 345-352.

Question 2

C.J. is a 2+9 yo male who was in good health until 3 days ago, when he tripped while running on level ground. He has refused to bear weight on his left leg since then, he "stands like a stork" when the parents attempt to entice him to walk. Parents deny any fevers or systemic symptoms. He is comfortable at rest and he will crawl on both legs, just not stand or walk. Clinical exam reveals no swelling or bruising, and he is distally neurologically and vascularly intact. Xrays of his left lower extremity are read as normal. Which option represents the preferred management of this patient?

- A. Bilateral hip ultrasound
- B. Bone scan
- C. Long leg cast immobilization with followup radiographs in 2-3 weeks
- D. MRI

Preferred Response: C

Discussion: The most likely diagnosis is a minimally displaced spiral tibia fracture, also known as a toddler's fracture. The fracture can be subtle on initial presentation, however, followup radiographs will demonstrate periosteal new bone formation indicating the presence of a fracture. Treatment is conservative, the fracture rarely displaces, and the long term prognosis is excellent. The fact that he is crawling suggests that the pathology is distal to the knee, making hip septic arthritis or toxic synovitis less likely. The acute nature of the injury and the lack of systemic symptoms points away from infection or tumor; however, if the child's condition does not improve as expected, a bone scan or MRI may be indicated.

References:

1. Tachdjian's Pediatric Orthopaedics, 4th Ed. Philadelphia: Saunders Elsevier, 2008: 2720.
2. Skaggs DL, Flynn JM. Staying out of Trouble in Pediatric Orthopaedics. Philadelphia: Lippincott Williams & Wilkins, 2006: 124-125.

Question 3

R.Y. is a 4yo female who fell while jumping on the bed onto his right arm. He sustained an isolated injury to his elbow. An AP view of his right elbow is shown below. He is distally neurologically and vascularly intact and comfortable at rest. Fracture displacement is approximately 1-2mm. Which option represents the preferred management for the aforementioned injury?

- A. Long arm cast application and followup in 1-2 weeks
- B. Long arm cast application and

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followup in 4-6 weeks

- C. Open reduction and internal fixation
- D. MRI

Correct Answer: A



Discussion: The patient has a lateral condyle fracture that is displaced approximately 1-2mm. Tachdjian's Pediatric Orthopaedics textbook states "lateral condyle fractures may be difficult to diagnose and have a propensity for late displacement, factors that make their treatment perilous." Fracture stability is primarily determined by the presence or absence of an intact cartilage hinge, a parameter which is difficult to evaluate by plain radiographs alone. Close followup is necessary to prevent the sequelae of a malreduced lateral condyle fracture. Repeat radiographs at 1-2 weeks are recommended; cast removal may be necessary to adequately visualize the fracture. Most pediatric orthopaedic surgeons agree that open reduction and internal fixation or closed reduction and percutaneous pinning should be performed for fractures that are displaced more than 2mm, as these fractures do extend into the elbow joint. MRI has been used to determine the integrity of the cartilage hinge, but the need for conscious sedation in young children makes this option less attractive.

References:

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3. Horn BD, Herman MJ, Crisci K, Pizzutillo PD, MacEwen GD. Fractures of the lateral humeral condyle: role of the cartilage hinge in fracture stability. J Pediatr Orthop 2002; 22(1): 8-11.
4. Finnbogason T, Karlsson G, Lindberg L, Mortensson W. Nondisplaced and minimally displaced fractures of the lateral humeral condyle in children: a prospective radiographic investigation of fracture stability. J Pediatr Orthop 1995; 15(4): 422-425

Question 4

L.R. is a 5yo male who sustained a widely displaced lateral condyle fracture. He was taken to the operating room for open reduction and internal fixation of the fracture via a lateral approach. Intraoperatively, the articular cartilage was anatomically reduced. Some plastic deformation of the lateral cortex was noted. When counseling the family, which complication would be the LEAST likely to occur?

- A. Growth arrest
- B. Cubitus varus
- C. Delayed union
- D. Lateral spur formation
- E. Late radial head dislocation

Preferred Response: E

Delayed union is a common complication of displaced lateral condyle fractures, likely due to poor blood supply. Cubitus varus may result from malunion, growth stimulation, or lateral spur formation, which can give the appearance of varus. Growth arrest with cubitus valgus is rare, but has been described. Late radial head dislocation can

occur with severe fishtail deformities, which rarely occurs with lateral condyle fractures, but this is distinctly uncommon.

References:

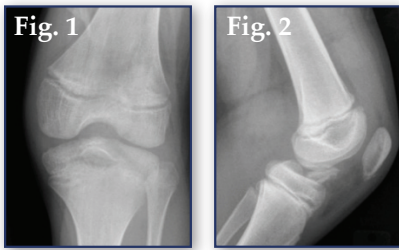
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Question 5

A patient sustained a twisting injury to the left ankle. The patient then underwent an initial radiograph and closed reduction followed by the CT scan seen in Figure 1 and 2. In what age group is this injury most commonly seen, and why does it occur in this age group?

- A. Late adolescent (age ~16-18yo); asymmetric closure of the physis (medial, central, lateral)
- B. Late adolescent (age ~16-18yo); closed distal tibia physis
- C. Early adolescent (age ~12-15yo); asymmetric closure of the physis (medial, central, lateral)
- D. Early adolescent (age ~12-15yo); asymmetric closure of the physis (central, medial, lateral)
- E. Pre-adolescent (age 8-10yo); open distal tibia physis

Preferred answer: D



The triplane fracture is commonly referred to as a “transitional fracture.” Prior to complete distal tibia physeal closure, there is a period lasting approximately 18 months in which the physis closes in a consistent pattern: central, anteromedial, posteromedial, and finally lateral.¹ Because of this pattern of physeal closure, the fracture typically occurs in children ~12-15yo (Mean age of 14.8yo in males and 12.8yo in females)². Initial radiographic findings demonstrate a Salter-Harris type III fracture on the anteroposterior radiograph and a Salter-Harris type II fracture on the lateral radiograph. After initial closed reduction, a CT scan is often indicated. Nondisplaced fractures with less than 2mm of joint displacement as well as extra-articular fractures can be treated with immobilization (typically initial long leg cast). Intra-articular displaced fractures of >2mm typically require open reduction and internal fixation.

References:

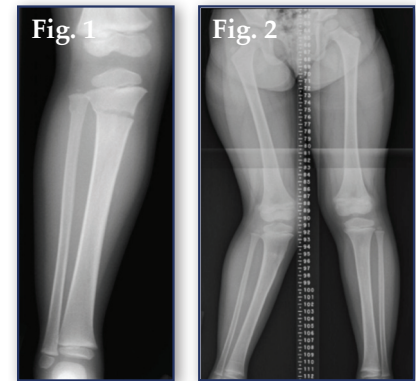
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Question 6

A 3-year old girl with knee pain and mild swelling after a fall presents to clinic with tenderness and a normal neurological and vascular examination. Radiographs demonstrate the fracture seen in Figure 1. Treatment in a long leg cast following a gentle reduction is instituted with uneventful fracture healing. Nine months from the time of injury, the child’s parents return with complaints of a progressive knee deformity involving the affected extremity. Radiographs are shown in Figure 2. The appropriate course of action at this time is:

- A. High tibial osteotomy for acute deformity correction.
- B. Proximal tibial epiphyseodesis to prevent further progression of deformity with staged tibial lengthening and deformity correction via distraction osteogenesis as the child nears skeletal maturity.
- C. Proximal medial tibial physeal growth plate tethering (guided growth) to allow for gradual deformity correction
- D. Application of a lower extremity unloader brace to reduce compression across the lateral proximal tibial physis and stimulate deformity correction via accelerated lateral tibial growth.
- E. Observation with expectation for spontaneous deformity correction.

Answer: E



This patient has post-traumatic tibia valga resulting from her proximal metaphyseal tibia fracture (frequently referred to as a “Cozen fracture”). Progressive genu valgum following proximal metaphyseal tibia fractures in children is fairly common. The deformity progresses most rapidly during the first year following the injury and often continues to progress at a slower rate for an additional 12 to 18 months.

The exact etiology of the deformity remains unclear. Though several theories exist regarding the cause of the Cozen phenomenon (inadequate reduction, medial soft tissue interposition at the fracture site, soft tissue imbalance due to lateral tethering by the iliotibial band, lateral physeal tethering by the intact fibula and unrecognized Salter-Harris V injury to the lateral tibial physis), asymmetric physeal growth due to differential stimulation of the medial tibial physis by hypervascularity or growth acceleration secondary to normal fracture healing is widely accepted as generating the valgus deformity.

In a long term follow-up study of patients with post-traumatic tibia valga, Tuten et al. demonstrated spontaneous correction of the deformity and clinically well aligned limbs at an average follow-up of 15 years from injury. As the majority of patients will spontaneously correct their tibial alignment with continued

continued on page 10

growth, interventions for deformity correction are not indicated until the child has been granted a prolonged time period to allow spontaneous correction to occur. Lastly, as this deformity occurs relatively frequently following proximal tibial metaphyseal fractures, it behooves the treating physician to counsel parents regarding the possibility of tibia valgum at the initiation of fracture treatment.

References:

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2. Jordan SE, Alonso JE, Cook FF. The etiology of valgus angulation after metaphyseal fractures of the tibia in children. *J Pediatr Orthop.* 1987 Jul-Aug;8(3):306-10.
3. Tuten HR, Keeler KA, Gabos PG, Zionts LE, MacKenzie WG. Posttraumatic tibia valgum children. A long-term follow-up note. *J Bone Joint Surg Am.* 1999 Jun;81(6): 799-810.
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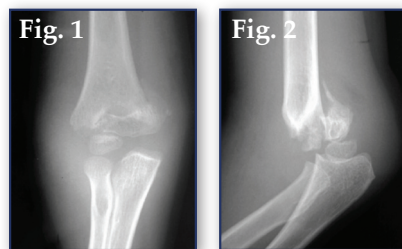
Question 7

A 6-year-old male presents to the emergency department after sustaining a fall from the swing at the local playground. He has pain and obvious deformity to his right elbow. The patient's fingers are pink and perfused, but there is no palpable

radial or ulnar pulse present in the emergency department. He is able to flex the DIP of his index finger and the IP joint of the thumb but will not extend his index finger. Radiographs of the injury are shown in the figures 1A and 1B. You decide to take him urgently to the operating room. The most appropriate management in the operating room includes:

- A. Closed reduction with placement of a well-molded long arm cast if reduction is adequate
- B. Closed reduction with percutaneous pin fixation, accepting slight gapping at the fracture site if alignment is appropriate and the hand remains perfused, followed by close observation for 24 hours
- C. Closed reduction and pin fixation followed by on table arteriography to look for arterial injury if pulse does not return
- D. Closed reduction with pin fixation only if an anatomic reduction is obtained, followed by close observation for 24 hours
- E. Open reduction with exploration of the neurovascular structures via an approach in the antecubital fossa

Preferred Response: D



Treatment of the “pink pulseless” supracondylar humerus fracture is a controversial topic. Arteriography is generally not warranted as the location of the injury is known. Indications for open reduction with exploration include a previously perfused extremity with acute

loss of perfusion or pulse after reduction, indicating an entrapment of the neurovascular structures at the fracture site. Open reduction is not indicated in the setting of a perfused hand unless an anatomic reduction cannot be obtained. If there is gapping at the fracture site when attempting closed reduction, the surgeon should convert to an open approach to ensure that the neurovascular structures are not entrapped at the fracture. Closed reduction and casting is not an appropriate management strategy for Type III fractures due to problems with maintaining a reduction and the risks of complications due to swelling in a cast with the elbow in a flexed position to maintain reduction, such as compartment syndrome. The patient who has a perfused hand but no pulse should be monitored closely as an inpatient for 24 hours to ensure continued perfusion and no signs of ischemia or compartment syndrome.

References:

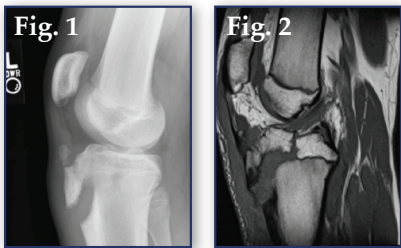
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2. Sabharwal S et al. Management of pulseless pink hand in pediatric supracondylar fractures of humerus. *J Pediatr Orthop.* 1997; 17: 303-310.

Question 8

A 15 year old basketball player has acute onset knee pain after trying to dunk. He is taken to the emergency department where the following x-ray and advanced imaging is obtained (Figures 2A and 2B). The family should be counseled on the potential for which of the following injuries associated with this fracture pattern:

- A. Premature physal closure causing a recurvatum deformity
- B. Compartment syndrome of the anterior compartment
- C. Concomitant anterior cruciate ligament disruption
- D. Medial meniscal tear
- E. Medial meniscus entrapment in the fracture

Preferred Response: B



Tibial tubercle avulsion injuries are high energy fractures involving the proximal tibial growth center in adolescents. The injuries represent an avulsion type fracture as the proximal tibia growth plate closes from posterior to anterior and from medial to lateral. Variations of the fracture pattern can extend through the epiphysis into the joint as is clearly shown on the MRI image. This can sometimes be difficult to detect on plain radiographs and recent authors have recommended obtaining advanced imaging such as MRI or CT scan to delineate intra-articular involvement. Intra-articular fractures with displacement such as shown require open reduction and internal fixation. A known complication from this type of injury with significant displacement is the development of a compartment syndrome in the anterior compartment due to damage to the recurrent anterior tibial artery. Premature physal closure is not an issue in a 15 year old because this is a transitional fracture which occurs as the growth plate is closing. If the patient was

significantly younger with growth plates open posteriorly, this would be a concern. Concomitant tearing of the anterior cruciate ligament has not been routinely described with this injury. Also, because of the growth plate closure from medial to lateral, the fracture usually extends into the lateral joint so lateral meniscal tearing and entrapment could occur, not medial meniscal entrapment.

References:

1. Pandya NK et al. Tibial tubercle fractures: Complications, classifications and the need for intra-articular assessment. *J Pediatr Orthop.* 2012; 32(8): 749-759.
2. Pape JM et al. Compartment syndrome complicating tibial tubercle avulsion. *Clin Orthop Relat Res.* 1993; 295:201-204

Question 9

A 2-year-old boy sustained the isolated injury shown in Figure 1 after falling from playground equipment. The injury was witnessed and there were no concerns for nonaccidental trauma. The most appropriate recommendation for treatment should consist of:

- A. reduction and internal fixation using flexible intramedullary rods.
- B. reduction and internal fixation using a submuscular locking plate.
- C. reduction and fixation using an external fixator.
- D. immediate spica casting under sedation.
- E. skeletal traction for 1-2 weeks followed by delayed spica casting.

Correct Answer: D



Spica casting remains the standard of care for diaphyseal femur fractures in this age group. Spica casting has been shown to be effective when the cast is placed by experienced personnel while the patient is relaxed and sedated. Immediate spica casting has not been shown to have a higher rate of fracture shortening or other complications compared to traction and delayed casting. Because of the generally excellent results of spica casting in small children, more invasive procedures, such as flexible intramedullary rods, submuscular plates, and external fixation, are reserved for an older age group.

References:

1. Infante AF, et al. Immediate hip spica casting for femur fractures in pediatric patients. A review of 175 patients. *Clin Orthop & Related Research.* 2000;376:106-112.
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3. Epps HR, et al. Immediate Single-Leg Spica Cast for Pediatric Femoral Diaphysis Fractures. *J Pediatr Orthop.* 2006;26(4):491-496.

Question 10

When treating a young child with a femoral shaft fracture, which statement below regarding proper technique for placement of a hip spica cast is correct?

- A. A short leg cast should be placed first, traction should be applied, and then the body and upper leg portions of the cast should be applied and molded.
- B. The cast should be applied with the hip and knee at 90 degrees (sitting spica cast)
- C. Traction should be applied first, followed by applying and molding the body and upper leg portion of the cast, followed by completing the short leg portion of the cast, with the hip and knee flexed less than 90 degrees
- D. The cast should be applied in an operating room under a general anesthetic.
- E. A double-leg spica cast should be applied.

Correct Answer: C

Spica casting has been shown to be effective when the cast is placed by experienced personnel while the patient is relaxed, whether in a setting using sedation or general anesthesia. Single-leg spica casts have been shown to be as effective for diaphyseal femur fractures as double-leg spica casts. To avoid the potential for compartment syndrome in the leg, the technique of placing of a short leg/ below knee cast first, applying traction and then casting to the trunk and opposite thigh with the hip and knee at 90 degrees flexion should NOT be used.

References:

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3. Mubarak SJ, et al. Volkmann Contracture and Compartment Syndromes after Femur Fractures in Children Treated with 90/90 Spica Casts. *J Pediatr Orthop.* 2006;26(5):567-572.

Question 11

A 13-year-old boy sustained an injury to his right knee while playing tackle football. He had immediate pain, and the inability bear weight. He was evaluated in a local emergency department, and his initial radiographs are shown in Figures 2a and 2b. In addition to open treatment of the injury with internal fixation, management should include:

- A. removal of hardware 6 months following the injury.
- B. contralateral distal femoral physeal arrest to keep his limb lengths equal.
- C. acute complete arrest of the right distal femoral physis and complete arrest of the left distal femoral physis to prevent leg length discrepancy.
- D. immediate weight bearing and knee range of motion exercises.
- E. close follow-up for one to two years to evaluate for physeal arrest, limb length discrepancy, or angular deformity.

Correct Answer: E



Multiple studies have shown a fairly high rate of physeal arrest following physeal injuries to the distal femur. Although individual studies list varying rates for physeal arrest, the overall rate is about 60%. The rate has been shown to be higher in cases where the initial fracture is displaced. Therefore, close follow-up to evaluate for this complication is mandatory. Hardware removal following fracture healing is an option, but remains controversial. Because of the high rate of physeal arrest, a contralateral procedure to prevent deformity could be considered, but most would not advocate a procedure on the normal leg when the incidence of arrest for each individual patient cannot be predicted. Because of the fracture instability, and relatively small amount of internal fixation used, most would advocate a period of immobilization and limited weight bearing until some healing is seen radiographically.

References:

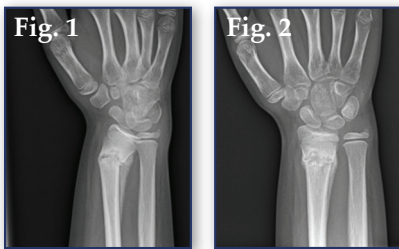
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Question 12

An 8 year old girl presents to your clinic with a splint on her right arm and a reported history of fall from monkey bars 4 weeks ago. X-rays are as shown (figure). The injury is closed and she is neurologically intact. Her pain is minimal. What will you advise as treatment?

- A. Four more weeks of long arm casting.
- B. Protective splint for one month, observation.
- C. Physical therapy.
- D. Open reduction and fixation.
- E. Closed reduction and casting.

Preferred response: B or D



The open physes on the radiographs are consistent with the reported history of an 8-year old girl, with hypothetically greater than 2 years of expected growth and remodeling potential. However, the angulation measures at least 40 degrees in the apex volar direction. Most authors have suggested that the outer limit for reliable remodeling in children under 10 years of age is 20-25 degrees. This is a controversial area. In cases where the deformity is greater than would be expected to

spontaneously correct, the patient and family should be counseled about the risks, benefits, and alternatives of both surgical and non-surgical management. The callus on this set of radiographs is mature and would be unlikely to yield with closed means alone, and attempting a forceful closed reduction may injure the distal radial physis. Physical therapy generally is not needed in pediatric fracture care. The most likely means of restoring normal anatomy would be an open reduction, with osteotomy through the callus/fracture, and fixation with pins. The option of observing the deformity for one year for remodeling, with osteotomy at one year from fracture if satisfactory remodeling is not seen, should also be offered.

References:

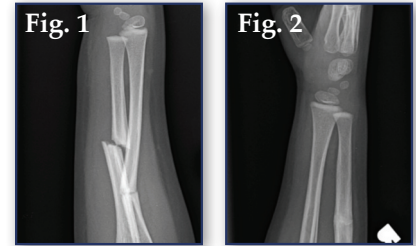
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3. Perona PG and Light TR. Remodeling of the skeletally immature distal radius. *J Orthop Trauma* 1990; 356-361.

Question 13

A 4 year old male had a both bone forearm fracture 2 months ago which was well aligned and treated by 6 weeks of casting. Within days after the last cast was removed, he fell again and had immediate pain in the same forearm. X-rays are as shown (figure). The parents are angry because you had told them his forearm was healed. What percentage risk of re-fracture exists after well-healed diaphyseal forearm fractures?

- A. 10% for the lifetime of the child.
- B. 5% for the subsequent 18 months.
- C. 5% for the subsequent 9 months.
- D. 1% for the subsequent 18 months.
- E. 1% for the subsequent 9 months.

Correct answer: C



There are several retrospective series which report on the rate of re-fracture after diaphyseal forearm fractures in children. Most of these cite a 5% rate. Bould and Bannister stated that the majority of re-fractures occurred within 9 months from the original injury, with a median of 8 weeks after cast removal. The rate of re-fracture slows down after the first 14-16 weeks.

References:

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Question 14

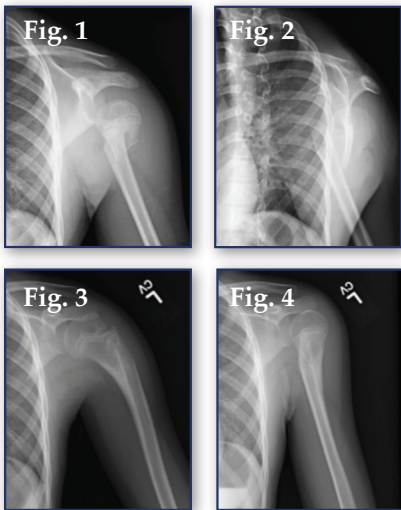
A 9 year old right hand dominant female sustains the proximal humerus fracture shown in Figures 1A and 1B. While counseling the family on treatment options, you

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inform them that:

- A. Although there are various surgical options, open reduction with locking plate internal fixation is the preferred “standard of care” treatment.
- B. Without surgery, she will likely have a permanent loss of internal rotation.
- C. Because the majority of upper extremity growth comes from the physes around the elbow, injury to the proximal humeral physis will be well compensated for by distal growth.
- D. Non-operative treatment such as a sling or hanging arm cast should result in normal range of motion and shoulder function within the year.
- E. Threaded pins should be avoided when fixing this fracture due to the increased risk of growth arrest.

Answer: D



The proximal humeral physis accounts for approximately 80% of this bone’s longitudinal growth. Due to this growth and remodeling potential, non-operative treatment is usually recommended for proximal humeral fractures in young children prior to adolescence. Figures 1C & 1D demonstrate the natural history of

the patient’s non-operatively treated fracture at 6 months after injury. In adolescents, this fracture has less time to remodel, so reduction with flexible nails or pin fixation is often recommended. Threaded Steinman pins offer better fixation than smooth pins; however, they usually require a return to the OR for removal.

References:

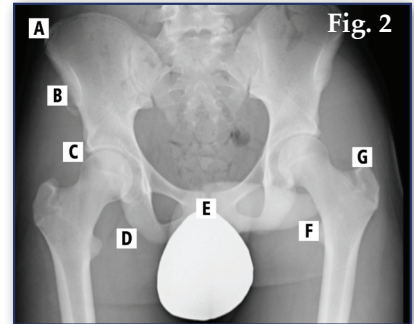
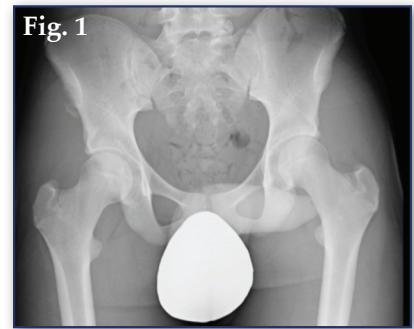
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Question 15

A 15 year old male reports sudden pain in his right hip while attempting the long jump at track and field practice. After obtaining the Xray in Figure 2A, you recommend the following:

- A. Immediate in situ screw fixation of his non-displaced slipped capital femoral epiphysis (pre-slip).
- B. Open reduction internal fixation of the indirect head of his rectus femoris.
- C. Open reduction internal fixation of the direct head of his rectus femoris.
- D. Protected weight bearing with crutch use and activity restrictions.
- E. MRI to assess for labral injury.

Preferred Response: D



This patient has sustained an avulsion fracture of the anterior superior iliac spine (ASIS). Because this is the attachment site of the sartorius muscle, physical exam of this patient would likely reveal point tenderness over the ASIS, pain with passive hip extension, and pain/weakness with active hip flexion. Forceful concentric or eccentric contraction of a muscle attached to a specific apophysis (Figure 2B) can result in an avulsion fracture at various sites around the pelvis, usually in patients in their mid teens to early 20’s. These fractures typically heal nonsurgically with abundant callus. Treatment recommendations include initial rest, ice, and analgesics for the first week, followed by gentle range of motion. Once motion is regained, gentle resistance exercises are typically started 2-3 weeks after injury, and more aggressive stretching and strengthening are increased 1-2 months after injury. Surgery is usually reserved for symptomatic nonunions, painful exostoses, and fractures displaced greater than 2-3 cm or if causing skin tenting or nerve impingement.

Sites of possible apophyseal avulsion

fractures with corresponding muscle attachment: A) iliac crest/ abdominal muscles; B) anterior superior iliac spine (ASIS)/sartorius; C) anterior inferior iliac spine (AIIS)/ rectus femoris (direct head); D) ischial tuberosity/hamstrings; E) symphysis pubis/adductors; F) lesser trochanter/iliopsoas; G) greater trochanter/gluteal muscles.

References:

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Question 16

A 5-year-old child presents to the emergency room after being struck by a motor vehicle. The child is found to have a Delbert Type II hip fracture and no other injury. X-rays AP and lateral views reveal angulation of 10° with 2 mm of displacement of the femoral neck. The best treatment option is:

- A. Closed reduction, spica cast application.
- B. Closed reduction, multiple cannulated screw fixation, open reduction if needed, spica cast application.
- C. Open reduction, single sliding hip screw fixation.
- D. Skeletal traction, delayed spica cast application.

Answer: B

The Delbert Type II fracture passes through the femoral neck. Osteonecrosis is reported in as much as 61% of these fractures. Closed reduction alone in the child greater than 4 years of age often results in late displacement and can contribute to osteonecrosis. If reduction is possible with less than 2 mm displacement and less than 5° of angulation percutaneous screw fixation insures maintenance of the fractures alignment. The 5-year-old child will usually not comply with limitation of activities and weight bearing. External mobilization is therefore needed. A single sliding screw used to stabilize this fracture will not control rotation and would require a small size implant that may not be available. Traction or casting alone often results in the development of varus deformity. Open reduction is necessary if the fracture is not reducible and is favored by some to decompress the intra-articular hematoma. Decompression of the hematoma may also be accomplished by aspiration after percutaneous screw fixation.

References:

1. Rockwood and Wilkins, *Fractures in Children*, 2005.
2. Cheng J, Tang N: Decompression and stable internal fixation of femoral neck fractures in children can affect outcome. *JPO* 1999;19:338-343.

Question 17

A 6-year-old boy was involved in a motor vehicle accident. He was not restrained and was sitting in the rear seat of a vehicle. He has stable vital signs, is alert, and complains of head pain. He has signs of ecchymosis of the forehead. Cervical spine films with cross table lateral views are performed. Subluxation of C2 on C3 is noted. Which of the following may

be used to distinguish injury from pseudosubluxation?

- A. Absence of soft tissue swelling on x ray.
- B. More than 2 mm displacement of C2 from Swischuck's line.
- C. Smooth contour of the spinolaminar line.
- D. All of the above.

Answer: D

Pseudosubluxation, which is an abnormal alignment of C2 on C3 seen on the lateral x-ray in children younger than 8, may be difficult to distinguish from injury in the setting of neck trauma. Injury to the cervical spine is more common in the proximal segments in children younger than 8. It is attributed to the fulcrum of motion being greatest at the C2-C3 level in the young child with a proportionately larger head, compared to the fulcrum at C5-6 level in the adult. Horizontal orientation of the facet joints and generalized ligamentous laxity also contribute to this predisposition.

A young child's head is disproportionately larger than an adult's. A cross table lateral x-ray may produce flexion of the cervical spine. The appearance of pseudosubluxation can be produced by this flexion. Performing an x-ray with a towel roll beneath the child's shoulders may produce a more natural lateral x-ray and the appearance of pseudosubluxation may be eliminated.

Two lines may be used to distinguish pseudosubluxation from injury -these are Swischuck's line and the Spinolaminar line.

Swischuck's line is drawn along the base of the spinous processes from C1-C3 on the lateral x-ray. The base of C2 spinous process should be within 2 mm of this line. The spinolaminar line is a curved line drawn along the bases of the spinous processes. This

continued on page 18

should define a smooth arc.

Soft tissue swelling of more than one third of the width of the vertebral body is abnormal in the anterior cervical spine above C4.

Despite the use of the above-mentioned criteria additional diagnostic studies such as flexion extension radiographs, CTscans and MRI may be needed to distinguish and define an injury to the pediatric cervical spine.

References:

1. Shaw M, Burnett H, Wilson A, Chan O. Clin Radiology 1999;54:377-380
2. Cattell HS, Filtzer DL. JBJS Am 1965;47(7):1295-1309.

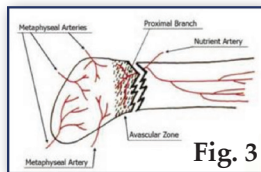
Question 18

12 year old female patient presents with foot pain after a twisting injury one week ago. She presents with the following xrays:

In regards to this injury:

- A. The patient should be treated in a hard sole shoe, weight bearing as tolerated.
- B. The fracture will heal without treatment due to the excellent blood supply at this location.
- C. The patient should be treated in a short leg cast weight bearing as tolerated until symptom free.
- D. The patient should undergo open reduction internal fixation with bone grafting.
- E. The patient should be treated in a short leg cast, non-weight bearing for a minimum of six weeks.

Answer: E



Fractures of the fifth metatarsal are very common in children with the fifth metatarsal being the most commonly injured after age 5. The above injury represents a “Jones” fracture, which is a fracture just distal to the proximal metadiaphyseal junction. The healing of these fractures can be delayed due to the vascularity in this area. It is considered a watershed area between the nutrient artery and the metaphyseal vessels.

These fractures are usually caused by either a direct hit to the foot or a twisting mechanism and are usually seen in athletes in the adolescent population. These injuries can be the result of repetitive stress or a traumatic event. Stress reaction at the site of the fracture can be indicative of stress prior to fracture.

In a study in the Journal of Pediatric Orthopedics, 15 patients with Jones fractures were treated with an average age of 14. In this study, delayed healing and non-union was noted almost exclusively in patients older than 13. They concluded that younger patients can be treated to union with non-weight bearing short leg casts while older adolescents may benefit from closed reduction intramedullary screw fixation with or without bone grafting to prevent non-union or refracture.

References:

1. Herrera-Soto JA, Scherb M, Duffy MF, Albright JC. Fracture of the Fifth Metatarsal in Children and Adolescents. J Pediatr Orthop. 2007;27:427-431. ▬

4. Can you give us any early information as far as your results?

We are about 20 patients into this and we have not seen a difference in the AVN rate between in-situ pinning and hips treated via surgical dislocation.

5. You and Dan Sucato are the two surgeons that run this trial and are called whenever an unstable SCFE comes in. In effect, this is a separate call for unstable slips and TSRH is probably one of the few institutions with this type of coverage. What do you believe are advantages and disadvantages of having an unstable SCFE call roster?

The primary utility is for execution of the randomized trial; Dr. Sucato and I are the only two surgeons performing the open reductions. Clearly, in-situ pinning is a procedure all pediatric orthopaedic surgeons can perform, but an open reduction is a far more complex. Recently, there has been a lot of

discussion whether this should be a procedure performed throughout the pediatric orthopaedic community. Dr. Sucato and I have completed additional training in this procedure, spent hours in the cadaver lab and performed numerous dislocations for other diagnoses prior to attempting an open reduction. We are developing an expertise in this procedure in order to provide the safest care that we can.

6. Going forward, do you think having a separate SCFE call is something that you may consider maintaining after the study is over in order to give the patients who come in all options? Should we move to another model that has been proposed where whoever is on general call pins the SCFE in-situ and if the deformity is significant enough, you or Dr. Sucato would perform a dislocation at a later date to improve the deformity?

I think that's an excellent question. One of the things this study may help us with is the timing of this procedure. There will certainly be a wide variety of patients who present within an hour of this becoming unstable or some will present days after it becomes unstable. If we can help answer that question "does time matter?" I think that will help answer this question. Currently, my belief is that there is a role for in-situ pinning and performing an open reduction in a delayed fashion. I think it should be done within six weeks from the time of in-situ pinning. Certainly, if you could offer the patient one surgery versus two surgeries, it would probably be better for them. That being said, if a surgeon does not have experience with an open reduction, performing an in-situ pinning and referring to an institution with greater expertise may be in the best interest of the child. —

Mark the date: Monday September 23, 2013 Fellowship Match Webinar

The BOS Match Committee will host a free webinar on September 23rd at 8pm Eastern titled "Tips for the Orthopaedic Fellowship Match. Webinar participants will learn helpful match statistics for each subspecialty match for the past 4 years, tips from program directors' and information on what to look for in choosing a fellowship. —

IPOS 2013: Learning at the edge...

Annual symposium offers unique, interactive and international learning experience

Now in its 10th year, the **International Pediatric Orthopaedic Symposium presented by AAOS and POSNA** is a premier educational event focused on treating orthopaedic conditions in young patients. This year's symposium will be held on December 4-7, 2013 at the Walt Disney World Swan Resort in Lake Buena Vista (Orlando), Florida

The four-day IPOS program, led by Course Director **Michael G Vitale, MD MPH**, is a unique blend of lectures, breakout sessions and hands-on workshops. Recognizing the diversity and subspecialty interests within pediatric orthopaedics, participants can customize their learning experience by choosing from a selection of over 45 breakout sessions, demonstrations, high-level hands-on technical workshops, and industry-sponsored sessions.

This year IPOS will further its innovative approach in a number of ways. Tuesday evening, for example, will provide an opportunity for early arrivals to come to a "Cases and Cocktail" session with residents who were awarded grants competing for "Best Case Presentation". The Masters Technique session will again be recorded so that IPOS attendees can access these technical tips year round. On Friday, IPOS will broadcast the Pediatric Trauma Breakout internationally in the first Webinar in IPOS history. And again, residents will compete during the surgical simulation program (Top Gun), again led by Don Bae this year.

"In organizing IPOS, we seek to have every square filled. Whether you are a PA, resident, Fellow or super-specialized experienced

surgeon, you should find programming of interest" says **Michael G Vitale, MD MPH**, course director. "IPOS seeks to speak to the diverse interests found in our field"

This year will include session on Managing Complications, Lower Extremity Problems in the Young Athlete, Innovative Techniques in the Pediatric Hip, Surgical Treatment of the Neuromuscular Patient, and Kids in the Clinic. Registrants can choose from five or six specialty breakout sessions on topics such as femoral acetabular impingement, principles of limb deformity correction, challenging sports cases, advanced Ponseti casting, hands-on pelvic osteotomy workshop, and selection fusion levels for idiopathic scoliosis. The course covers all areas of pediatric orthopaedics—including sports medicine, trauma, spine, hip, upper extremity, and more, from frequently-seen problems to rare conditions that demand specialized care.

International influence

The unique perspectives that international faculty bring to the program is one of the attractions of IPOS. "They often bring cutting-edge ideas not yet popular in the U.S and actively debate with the U.S. faculty on the optimal care for different conditions," notes **Dr. Jack Flynn, Co Chair of IPOS 2013**.

Whether you are an experienced orthopaedic surgeon, resident, fellow, or allied health provider, if your practice includes children or young athletes, this symposium updates you on today's cutting-edge issues in pediatric orthopaedic surgery and prepares you to meet the diagnostic, procedural, and management challenges of their care needs.

Call for Resident Participation

Residents are being strongly encouraged to submit a structured case presentation which will be graded by the advisory board. The top presentations will be selected for presentation on the new Tuesday eve session. Additionally, residents and fellows will be asked to participate in the Thursday evening Top Gun presentation.

For more information about IPOS 2013, visit <http://www.posna.org/ipos/ipos.asp>. —

