



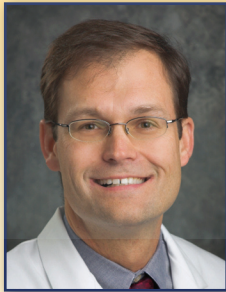
March 2013

Resident *Review*

Cutting Edge Orthopaedic Information Enhancing Resident Education

From the Editor,

Steven L. Frick, MD



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Welcome to the Winter 2013 edition of the POSNA Resident Review. This edition features an interview with Lori Karol, who has been a stalwart in the excellent clinical, educational and academic pediatric orthopaedic programs at the Texas Scottish Rite Children's Hospital in Dallas that have transformed our profession.

Typical for many pediatric orthopaedic surgeons, she is an expert in many areas of children's orthopaedics and her clinical practice covers a wide spectrum. As medical director of the gait lab at TSRH, she has helped apply this technology and knowledge to studying the effects of our interventions on function in children, making substantial scholarly contributions. In addition to her academic contributions, she has been involved heavily in volunteering for orthopaedic professional societies. Dr. Karol also balances her professional and personal/family life well, and is an excellent role model for residents and fellows. We are appreciative of the time she devoted for this edition's interview.

The clinical focus of this edition is pediatric sports medicine, a growing subspecialty area. As our society continues to value and promote participation in youth sports, and glorify those who are successful later at the highest levels, our patients and their parents will experience injuries and conditions that limit sports participation, and also seek out our counsel to help them maximize their musculoskeletal function. Managing patient and especially parental expectations in this patient population can be challenging, but rewarding. As our knowledge and surgical capabilities have expanded, we have seen individuals who dedicate their practice to pediatric sports medicine extend the age range of their patients beyond the traditional 18 year old boundary, and continue to care for patients

Technology Corner:

POSNA Educational Resources Review

By Orrin Franko, MD

This column will review the most useful online educational resources for orthopaedic trainees. Most of these websites are probably familiar to residents, but I hope to identify unique features that can help expand your education.

Wheless' Textbook or Orthopaedics (www.whelessonline.com)

For many residents, Wheless is their first exposure to online orthopaedic reference material. As an online "textbook" and reference source, this comprehensive listing of orthopaedic conditions benefits from an easy search function and expansive cross-referencing. In addition to providing bullet-point information for the most commonly tested and pimped questions, each page includes a list of references for "classic" articles and additional reading. Generally speaking, Wheless is most useful as a point-of-care reference source while on call or during last-minute case preparations. However, the website lacks any form of quiz feature, does not include the ability to discuss topics, and the frequency and accuracy of updates is unverified.

Cautions: Explanations are brief, important details are often missing, and references may be outdated

VuMedi (www.vumedi.com)


VuMedi advertises itself as the "YouTube" for specialist physicians. Although originally only for orthopaedics, their video library now includes cardiology, neurosurgery, primary care, plastic surgery and radiology and currently boasts over 2,000 videos. The appeal of VuMedi for residents is the price (free) and the ability to watch entire lectures or surgical procedures on very specific topics (i.e.: Direct Anterior Approach Total Hip Arthroplasty). However, the site is not without controversy. While many "well known" surgeons have posted technique videos and lectures, other videos have been criticized for teaching poor technique. Although the site does allow users

From the Editor (from page 1)

through the high school and college years when they are most active in sports.

The Editorial Board hopes you enjoy the information about our specialty in this edition, at a time of year when those of us in pediatric orthopaedics

in North America are readying for a bolus of new scientific information about our specialty. The POSNA annual meeting in Toronto this May is always the highlight of the year for learning about the latest studies and techniques, and an opportunity to catch up with friends and colleagues

to discuss better ways to help our patients. I hope you will be able to take advantage of these opportunities to learn- if you are unable to attend, much of the educational content is available after the meetings on the society website, www.posna.org. 

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

to “thumbs up” videos they like and post comments, this may not prevent trainees from watching videos that promote techniques unsupported by peer-review. The website also hosts a number of live Webinars with leaders in the field who provide live lectures on particular topics, making VuMedi a resource for both residents and practicing surgeons alike.

Cautions: Videos are not peer-reviewed and may teach unverified techniques

OrthoBullets
(www.orthobullets.com)

Orthobullets.com entered the realm of educational resources with the belief that orthopaedic education can be made more efficient. In that regard, the site is designed in an integrated review format that

incorporates bullet-format learning points, images, tables, questions, explanations, and discussion comments. In


addition, unlike other websites, Orthobullets has teamed up with the Miller Review Course to create an online review curriculum and emails out daily study plan guidelines for enrolled residents (free). Each email provides a link to specific topics that integrate questions and images into the topic, and even includes a “classic article” each day. Although this feature is brand new, most residents agree that if the study plan is strictly adhered to, there is no question that board scores will significantly improve. The website includes social networking components, such as subscriptions to groups, interesting case discussions, and the ability to send messages. Lastly, one of the most popular features is the QBank, comprised of over 2000 questions, which allows users to create tests of varying lengths and topics.

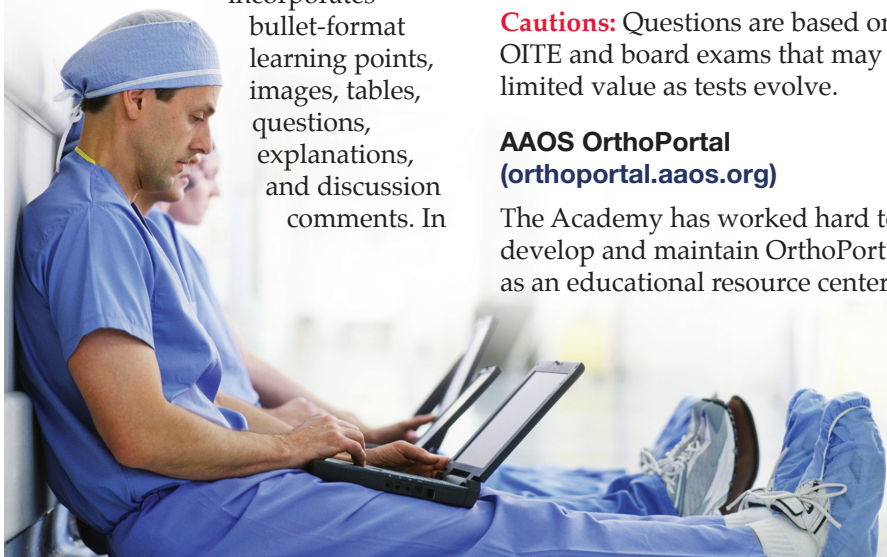
Cautions: Questions are based on old OITE and board exams that may be of limited value as tests evolve.

AAOS OrthoPortal
(orthoportal.aaos.org)

The Academy has worked hard to develop and maintain OrthoPortal as an educational resource center for

residents and surgeons. The portal attempts to integrate a variety of educational modules, including journals (JAAOS, OKO Journal, JBJS Am), CME credits, eBooks (AAOS publications), eMedia (video and lectures), eStudy (resident study center), and patient education. For residents, the most valuable modules are in the residents’ study center. OrthoQuiz is the AAOS version of QBank and includes 700 questions. Unfortunately, unlike other question banks, explanations are not provided for answers; however references for additional reading are included. The site also includes the Resident Practice Management Lecture Series and ResStudy with 1000 questions and self-assessment examinations, but these features are not free and require a subscription. While the AAOS certainly has a reputation for peer-review and trustworthy information, the limited number of resources and high price will prevent most residents from making this their top choice for studying.

Cautions: Limited numbers of questions and resources, expensive relative to other options. 



Interview with Lori Karol, MD: February 12, 2013

By Anthony Riccio, MD and Craig Ebersson, MD

1. You have been very involved in numerous orthopaedic specialty societies. What advice do you have for residents and young surgeons looking to contribute to organizations like POSNA?

The advice that I would give is to never say “no” when somebody from an organization asks you, “do you want to become involved in something?” It may not be the first committee you would have chosen for yourself. On the other hand, you will meet people and, particularly at POSNA, the people you meet are going to be your peers with whom you will share your career. So if someone asks you to become involved, say yes.

The second thing is, don’t be afraid to volunteer. Not every young pediatric orthopaedic surgeon may be familiar with the people picking members for a committee. If you are in a location where your senior partner or junior partners are not that active in POSNA, it does not mean that you cannot be- but you have to volunteer. If you know someone on the board of directors, send them a note and say “I’m interested in trauma. If there is an opening on the trauma committee, keep me in mind.” Or, “I’d like to become involved in committee work, keep me in mind.” And that will go a long way. If you never ask, you cannot get upset that you weren’t asked by the organization.

Third, if you do have an active senior partner, talk with them about it. It is likely that they have been involved in POSNA, Scoliosis Research Society, AAOS or the AACPD at some point

during their career and may still be involved. They will put in a word for you, if you tell them you are interested in committee work.

Finally, submit your abstracts and get up on the podium at the annual meeting. This will help you establish a presence in your society. Over time, invitations to speak or become involved in society work groups come to familiar faces.

“...I went to medical school was to take care of children and that is what brings me the greatest satisfaction.”

2. Has it been difficult balancing a full-time clinical practice with your extensive research endeavors?

I always laugh that I need to be cloned three times over. One of my clones would be the research clone. Yes, it is difficult, but if you are interested in doing research you have got to make the time to do it. I write nearly all my papers on airplanes. On an airplane, my phone can’t ring and I don’t have to go to a school basketball game. It is time where I am not doing anything productive, so rather than watching the movie, I write papers on the airplane. As the Medical Director of the Movement Science Lab, I have several people who work in that lab and I feel a moral responsibility that they get their paychecks because we accomplish research. If I don’t do my job, I can’t justify the fact that

they have positions within the hospital.

The funding you get for research is based on your productivity - so if you are involved in research, you have got to put the papers out there. You just need to become very efficient with your time.

3. What is the most rewarding aspect of your practice?

Patient care. That took about two seconds to come up with that answer. I do a lot of things. I operate, I see clinic, I go to the Gait Lab, I write papers, I serve on committees at the hospital, I serve on committees in national organizations, but the whole reason I went to medical school was to take care of children and that is what brings me the greatest satisfaction.

4. Tell me about the aspects of your early life that inspired you to pursue a career in orthopaedic surgery?

As far as going to medical school, I have a really funny story. I was a senior in high school. I was a little bit of a young senior- I was 16 years old- and I came from a background that we didn’t have a lot of money. I was the oldest of three kids, and I had received a full scholarship to the local university. I didn’t want to go there. I wanted to go to Michigan but I did not have a full scholarship at Michigan.



continued on page 4

My father said that if I was accepted into a program at Michigan that they didn't have at the local university, I could go to Michigan. So I looked and found the combined premedical/medical school program which they didn't offer at the college where I had my scholarship. I was 16 years old, and there's nothing mature about a decision at 16 years old, but I got in. I actually started medical school for the sole reason of going away to school to go to Michigan. It worked out great, and I think that there was probably an element of fate in it. As far as orthopaedics, much of why you decide what specialty you are going to pursue is based on the residents you become involved with when you are on that rotation. So I spent four weeks on an orthopaedic surgery rotation and there were six women in the orthopaedic program at Michigan. I didn't think it was weird that I enjoyed orthopaedics. I worked with great residents and they saw that I enjoyed what I was doing, so they let me do more. I was reducing fractures, placing casts, scrubbing in on surgery. The more I did, the more I loved it. It became very clear that I should do orthopaedics.

5. Why pediatric orthopaedics?

Kids! As I was rotating through my orthopaedic rotations, I had done trauma. I had just come off an adult rotation and I was becoming a little unhappy because I had not found what really made me "tick" yet. I went to Children's Hospital and I worked with Dick Lamont, who was a very, very kind man. I also worked with David Aronsson and Randy Loder. All of a sudden, I

realized - this was it. This was what I wanted to do. I was in a residency program where I got to spend 40 weeks doing pediatric orthopaedics, and it was scattered throughout three of my training years. Every time I went back to pediatrics, it became clear that this was what I was meant to do. I was not predestined to be a pediatric orthopaedic surgeon from the time I was seven years old- I grew into it; based on my rotations I had done and how much I enjoyed what I was doing.

"He gave me the chance to be an orthopaedic resident at a time when there really weren't very many women in orthopaedics."

As pediatric orthopaedic surgeons, we are given a huge opportunity to influence the life of a young person with a long future in front of them. For many of our patients, we become an important part of their childhood and development, and have the privilege to watch these young children grow up into young adults. We get to know their families. This is what is special about pediatric orthopaedic surgery.

6. Tell me about some individuals who inspired you and helped you along the way and what made them effective mentors?

I call these guys my "Orthopaedic Godfathers." There were several people along the way who really helped me become who I am, and helped me tremendously. They

gave me opportunities that other people didn't have because they weren't lucky enough to work with them. The first one was Dick Lamont. Dick was not a president of POSNA. He was a member, but he was a quiet member. He was the Chairman of Orthopaedics in my residency program when I started and he was the father of many daughters. I think he took me under his wing a little bit. He really looked out for me. When I decided I wanted to become a pediatric orthopaedic surgeon, I think it just absolutely tickled him. He gave me the chance to be an orthopaedic resident at a time when there really weren't very many women in orthopaedics. I was only the second woman in my program, and the first one had graduated many years before. He gave me the chance. The other two people who I really owe my decision to become a pediatric orthopaedic surgeon are David Aronsson and Randy Loder. They were the junior faculty at Children's when I was in Detroit. They were who I wanted to be when I grew up. They took wonderful care of patients. They taught residents. They held themselves and the residents to very high clinical standards. They performed research. I learned a tremendous amount about research from them, particularly mining databases and becoming an expert in something. Randy Loder and David Aronsson, at the time when I was a resident, were very, very involved in slipped capital femoral epiphysis research. Today, when you read and do research on SCFE's their names pop up all over the place. They taught me that you find an area and you pursue it. You explore that clinical problem

from every angle. I believe that is what we have done in our lab for clubfeet. I learned that thanks to their mentorship.

7. **How valuable do you think mentorship is to our residents and young surgeons and how can we do a better job providing mentorship to the next generation of surgeons?**

I think mentorship is very important. However, I don't think that you go through your career with one mentor. I think mentorship evolves over time. When I became a fellow at Texas Scottish Rite Hospital for Children, Tony Herring became one of my most influential mentors, and he still is. Each step of the way, you will find people you look up to and you can go to with problems, but it doesn't have to be the same person your entire career. I think an assigned mentor in a residency program is a place to start, but it's probably not enough. When I'm assigned a new resident to mentor, I meet with that resident regularly, but that resident may not have any interest in pediatric orthopaedics two years down the line. The resident who becomes interested in pediatric orthopaedics will establish a relationship with me during the time they spend on my service or at our hospital. I think you will find the mentors based on your clinical interest throughout residency.

8. **You are considered a leader in our field, what can residents and young surgeons do to develop leadership skills early in their careers?**

I think we have opportunities to grow into leadership. Leadership does not happen immediately. You don't leave residency or

fellowship and become a leader in pediatric orthopaedics in one or two years. The way that you grow into leadership, is by working hard in your early years and becoming involved. There are also a few opportunities for leadership training programs. I was a Leadership Fellow at the American Academy of Orthopaedic Surgeons. What many people don't know is that program was actually started by Vern Tolo, who is one of our senior pediatric orthopaedic surgeons and past president of

“I think we have opportunities to grow into leadership.”

POSNA. He felt that there was a need to develop leadership skills in young orthopaedic surgeons and I benefitted from that program. I also benefitted from the fact that Vern served as my personal mentor that year. I was mentored by the very best- by the person who actually started the program. Applying for and participating in these programs is useful. Always saying “yes” to an opportunity that comes up is useful and then, let it happen.

9. **An increasing number of women every year are pursuing careers in orthopaedics, but that wasn't the case when you trained. Was it difficult being a female resident in what, at the time, was a fairly male-dominated profession?**

It was a blessing and a curse. I think that as the only woman resident for most of my resident training, there was a little bit of a spotlight on me. The spotlight

shone very bright when I did something well, but if something didn't go well, the spotlight was on me too. So, I think that some aspects of it were difficult. I didn't have a resident in the locker room with me. No matter how you look at it, there are a lot of things that get discussed off hours, in a locker room, that I wasn't necessarily privy too. But, I worked with guys that I got along with extremely well, and I hate to say it, but I became “one of the boys.” I really was just “one of the guys” so I never considered myself unfortunate for being the only woman in the program. In many ways, I was given opportunities. In my senior year of residency, I was named chief resident and I was basically the chief resident with a bunch of male orthopaedic residents. I never felt different from them and I hope that they never felt I was different from them either. We worked as a team.

10. **Do you have any advice for female residents and those female medical students considering a career in orthopaedic surgery today?**

I think female residents and medical students do not feel as frightened of orthopaedics as perhaps we did coming out of medical school in the 80's. There are more women role models for the residents and medical students now than there ever have been before. If orthopaedics is what you enjoy and your orthopaedic rotation makes you happier than any other rotation you are on- whether you are a woman, a man, or monkey- you should do orthopaedics. Gender should not make a difference.

11. **What has changed in pediatric orthopaedics since you started practice?**

Clinically, a lot of things have changed. I'm not treating clubfeet like I used to, and clubfoot release used to be my most common operation. Now, it's one of my least. What has not changed are the patients. The parents and the patients still come to us with problems and are looking for solutions. How I treat scoliosis is different now than how I treated scoliosis as a fellow. The instrumentation is different, but the concepts are the same. The specifics of how we treat the conditions has changed, but the problems haven't, and how I look at patient care really hasn't changed. There has been a tendency to fragment pediatric orthopaedics into subspecialties since I started practice. This hasn't really happened for the most part at TSRH, and I'm still a general pediatric orthopaedic surgeon. But the trend is there, and we'll see what the future brings.

12. **What does the future of healthcare mean for the pediatric orthopaedic surgeon?**

If I knew that, I would be on a healthcare committee with the

government. I have no idea. We're going to all be reading the newspapers together and figuring this out. I think there will be changes. I think that children will benefit from universal healthcare. How this all comes about, I have no idea.

13. **What do you do for fun?**

I go to a lot of sporting events for fun. I have three girls. Two of my girls are now in college and the last one is in high school. I am a permanent "bleacher creature." My daughter plays volleyball and basketball and I don't miss a game. When the girls were younger, I became involved in coaching their teams and leading booster clubs. I wouldn't have traded that time with them for anything.

14. **Has it been difficult balancing family life with your career?**

Of course. I think that any orthopaedic surgeon needs to marry well. I think that a woman orthopaedic surgeon needs to really embark on a family with a spouse who is a partner. I could not have done this alone. I married probably the most amazing man in the history of the universe. He has been there

with me, helping raise our family together. There are times when I am not at home and really wish I were. If there is a patient that needs me for something that cannot wait, there is no excuse not to be there for that patient and my kids understand. When I come home from work and we sit around the dinner table, we talk about the cases that I did. When I'm on call and have to go in and fix a fracture, my daughter says, "is it a femur and how are you going to do it?" So, orthopaedics is part of our family life too. You get 18 years with your children. You don't get 19 or 20 or 25. They will go away to college after 18 years. You want to do your best during the 18 years you have with them to raise them with proper values. You want to be there for them as much as you can and if it means you sleep two hours less on a Thursday or Friday or Monday night because you were at a school event and then did your paperwork at a late hour, that's what you do. I think as the mom in the family, at times I feel the need to be present more often and at hours that are not easy to be there, but I try to make the effort to do that. —

Call for Abstracts

The Call for Abstracts for the 2013 Section on Orthopaedics academic and scientific program at the AAP National Conference & Exhibition (NCE) is now open. To submit an abstract visit <https://aap.confex.com/aap/2013/cfp.cgi>

PLEASE encourage residents, fellows, and medical students to submit an abstract. Prizes – \$1,000, \$500, and \$250 – will be given for the top three abstracts presented by residents, fellows, and medical students.

For background on the Young Investigators Awards, please visit <http://www2.aap.org/sections/ortho/orthoawards.htm>

Deadline for submissions is Friday, April 12, 2013. Access will be available to complete submissions until Sunday, April 14, 2013 (to allow for international submissions to be completed without issue). —

Pediatric Sports Medicine: Challenging Cases- what would you do?

Question 1

An 11-year-old male presents to clinic with several weeks of knee pain and no history of recent injury. He denies locking, catching or loose body sensations. On examination, he has full range of motion and no effusion. Plain radiographs and an MRI are shown. The MRI reveals no disruption of the articular cartilage surface. When counseling this patient's parents about this condition, you should inform them that:

- A. A trial of non-operative treatment with activity restriction and immobilization is indicated but is only successful in a small minority of patients.
- B. Surgical treatment is necessary to prevent progression of the lesion, possible detachment and early osteoarthritis.
- C. Size of the lesion has not been found to be predictive of healing potential
- D. No treatment is required as these lesions universally heal in patients with open growth plates
- E. The absence of mechanical symptoms is a positive predictor for healing of the lesion with non-operative treatment.

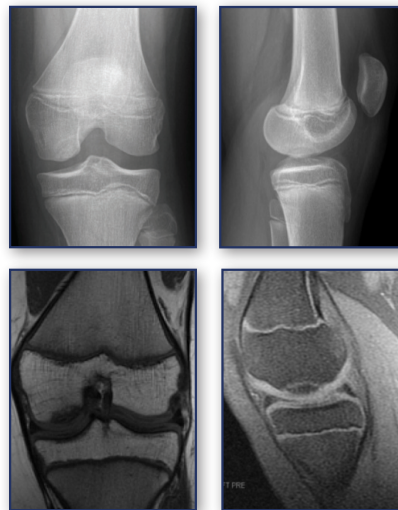
Preferred Response: E

Discussion: This patient has juvenile osteochondritis dissecans of the knee. The condition results from focal avascular necrosis that affects the subchondral bone and articular cartilage. Lesions are most commonly encountered at the lateral aspect of the medial femoral condyle. In children, these lesions are often stable with intact overlying articular cartilage. Several studies have shown that many stable lesions eventually heal following non-operative treatment in the form of activity

restriction or immobilization with radiographic healing rates ranging from 50-95%.

Recent research has focused on identifying characteristics of osteochondritis dissecans lesions that are predictive of healing with non-operative care. Wall et al found that larger lesions and those lesions associated with knee swelling and/or mechanical symptoms were less likely to heal after 6 months of conservative treatment. Though Wall et al found no association between patient age and healing, prior research has indicated that younger patients have higher healing rates than older children.

Surgical intervention is indicated when children present with unstable lesions or for those children in whom non-operative treatment fails to result in healing. Surgical treatment varies based upon status of the articular cartilage and severity of the subchondral necrosis. Options range from arthroscopic drilling in an attempt to promote healing to fixation of the lesion with or without bone grafting.



References:

1. Kocher MS, Tucker R, Ganley TJ, Flynn JM. Management of osteochondritis dissecans of the knee: current concepts review. *Am J Sports Med.* 2006 Jul;34(7):1181-91.
2. Hefti F, Beguiristain J, Krauspe R, Möller-Madsen B, Riccio V, Tschauer C, Wetzel R, Zeller R. Osteochondritis dissecans: a multicenter study of the European Pediatric Orthopaedic Society. *J Pediatr Orthop B.* 1999 Oct;8(4):231-45.
3. Wall EJ, Vourazeris J, Myer GD, Emery KH, Divine JG, Nick TG, Hewett TE. The healing potential of stable juvenile osteochondritis dissecans knee lesions. *J Bone Joint Surg Am.* 2008 Dec;90(12):2655-64.

Question 2

A 10-year old male presents to clinic with a several month history of lateral sided knee pain and intermittent sensations of snapping, particularly during athletic activities. On examination, he lacks a small amount of terminal knee extension and McMurray testing elicits a palpable clunk along the lateral joint line. A plain radiograph of the knee and MRI images are shown. What is the most appropriate course of action?

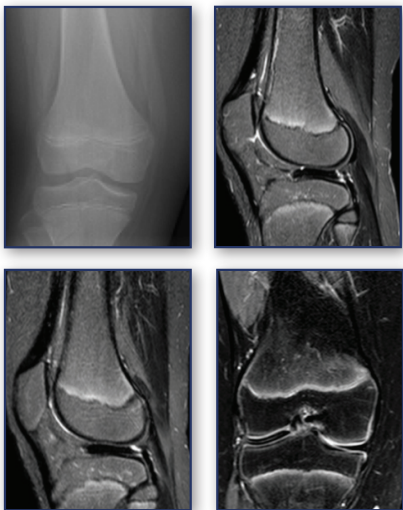
- A. Physical therapy for knee range of motion and iliotibial band stretching
- B. A short course of non-steroidal anti-inflammatory medication and 6 weeks of activity restrictions
- C. Arthroscopic loose body removal, assessment of cartilage integrity and possible microfracture

continued on page 8

- D. Arthroscopic meniscal saucerization, assessment of meniscal stability and possible meniscal repair.
- E. Arthroscopic total meniscectomy with staged allograft meniscal transplantation.

Preferred Response: D

Discussion: This patient's history and clinical examination are consistent with a diagnosis of a symptomatic lateral discoid meniscus. The plain radiographs demonstrating subtle asymmetric widening of the lateral joint line in comparison to the medial side and the MRI studies confirm the diagnosis. An asymptomatic discoid meniscus, while prone to an increased risk of meniscal tearing, requires observation only. Surgical intervention is recommended for discoid menisci that are torn or cause pain and bothersome snapping. The preferred treatment is arthroscopic meniscal saucerization, with careful intra-operative assessment of meniscal stability. In a consecutive series of 128 symptomatic discoid menisci, Klingele et al found that nearly 30% lacked normal posterior capsular attachments. In the presence of such peripheral rim instability, consideration should be given to meniscal repair following saucerization as saucerization alone may not eliminate the patient's mechanical symptoms.



References:

1. Klingele KE, Kocher MS, Hresko MT, Gerbino P, Micheli LJ. Discoid lateral meniscus: prevalence of peripheral rim instability. *J Pediatr Orthop.* 2004 Jan-Feb;24(1):79-82.
2. Kramer DE, Micheli LJ. Meniscal tears and discoid meniscus in children: diagnosis and treatment. *J Am Acad Orthop Surg.* 2009 Nov;17(11):698-707.

Question 3

Tom, a 10 year old basketball player is cutting to the rim for the game winning shot as his best friend Steve, the shot putter, trips and rolls backward onto the knee resulting in a hyperextension injury that made many in the crowd nauseous. On the floor he is noted to have significant swelling and a positive Lachman exam. An AP and Lateral radiograph is taken in the ED, the next appropriate step in treatment is:

- A. Excision of Bone Chip and Trans-epiphyseal ACL Repair
- B. Excision of Bone Chip and All-epiphyseal ACL Reconstruction
- C. Closed reduction in ED and application of cast in 30 degrees knee flexion
- D. Open or arthroscopic reduction and fixation.
- E. Check anterior compartment pressures for impending compartment syndrome

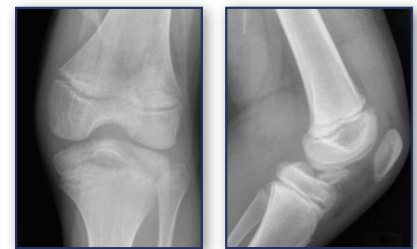
Correct Answer: D

Discussion: This child has sustained a tibial spine fracture and the ACL is expected to be intact and attached to the bony fragment. ACL reconstruction or repair would not be indicated. These children are not at high risk for compartment syndrome, in contradistinction to tibial tubercle fractures. Tibial spine

avulsion injuries can be treated open or closed in deference to the displacement of the fragment. Type 1, non- displaced fractures are treated in an immobilizer with rehabilitation when healed. Type 2 fractures where the posterior cortex is intact but slightly levered up anteriorly; may be a candidate for knee aspiration and reduction and casting in extension. Type 3 fractures where the fragment is completely displaced are treated with reduction and fixation.

References:

1. LE Zionts, Fractures about the knee in children *J Am Acad Orthop Surg.* 2002 Sep-Oct;10(5):345-55.



Question 4

A 17 year-old high school football player sustains a traumatic anterior shoulder dislocation which requires reduction under general sedation. A post-injury MRI is demonstrated in the figure. The patient has questions about returning to play football- he and his family should be counseled that:

- A. Patient may not return to contact activities due to the increased risk of progressive osteoarthritis to the shoulder.
- B. Patient may return to contact activities after undergoing physical therapy to regain strength and range of motion and is at no significant increased risk of subsequent dislocations.

- C. Patient may return to contact activities only after he undergoes surgical treatment for his shoulder pathology.
- D. Patient may return to contact activities after undergoing physical therapy to regain strength and range of motion but it at high risk of developing subsequent episodes of instability.
- E. Patient may return to contact activities immediately if there are no neurovascular injuries.

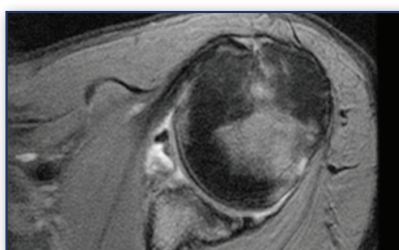
Preferred Response: D

This patient has demonstrated a first time anterior dislocation in a contact athlete with an MRI that shows an associated bony Bankart lesion. Glenohumeral dislocations in adolescent athletes are concerning because of the high risk of recurrence in these young active patients. Redislocation rates have been reported as high as 100% by Marans et al when retrospectively looking at 21 skeletally immature athletes treated in a sling for 6 weeks. Other studies have demonstrated the rates of recurrent instability in patients under the age of 30 to be between 75-90%. Surgical treatment for first time dislocators is controversial, but can be considered based on the high likelihood of subsequent dislocation and dependent on the patient's projected physical activity. In addition, surgery can be delayed until after the acute season if the patient undergoes rehabilitation that helps restore symmetric range of motion and strength, but the family needs to be counseled on the potential risk of recurrent instability.

References:

1. Marans et al. the fate of traumatic anterior dislocation of the shoulder in children. *J Bone Joint Surg Am.* 1992; 74:1242-4.

- 2. Hovelius L. Shoulder dislocations in Swedish ice hockey players. *Am J Sports Med.* 1978; 6:373-7.
- 3. Robinson CM et al. Functional outcome and risk of recurrent instability after primary traumatic anterior shoulder dislocation in young patients. *J Bone Joint Surg Am.* 2006; 88:2326-36.
- 4. Taylr DC and Krasinski KL. Adolescent shoulder injuries: consensus and controversies. *J Bone Joint Surg Am* 2009; 91: 461-73.



Question 5

A high school junior aged female presents to clinic complaining of right shin pain. She started running cross country during her freshman year and is getting ready to start her junior season. She stopped having menstrual periods 6 months ago after 3 years of normal menstruation and her mother reports that the patient has lost 20 pounds over the last year. The radiographs are shown in the figure. The next step in management should consist of:

- A. Percutaneous or open biopsy of the lesion and consultation with an oncologic specialist.
- B. CT of the chest, abdomen, and pelvis to look for a primary tumor source.
- C. Operative fixation with open reduction and plate fixation with bone grafting
- D. Activity restrictions, cessation from running, possible referral to a counselor for eating disorder

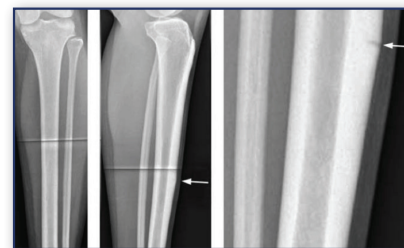
- E. MRI to better characterize the lesion

Preferred answer: D

This case represents an anterior tibial stress fracture in an adolescent female. The clinical course represents the "female athlete triad", which is represented by the combination of an eating disorder, amenorrhea, and osteoporosis. Although anterior tibial stress fractures have been shown to be difficult to heal, and might eventually require operative treatment, an attempt should first be made to treat the fracture with conservative measures, including cessation of running activities, modifying the weight bearing status, and treating associated pathology including eating disorders. In the differential for stress fractures are primary bone tumors and infection, but this patient was exhibiting the classic clinical features of a stress fracture. In this case, the stress fracture is readily apparent on plain films and an MRI would be unnecessary for diagnosis.

References:

- 1. Coady CM and Micheli LJ. Stress fractures in the pediatric athlete. *Clinics in Sports Medicine* 1997; 16(2); 225-238.
- 2. Boden BP and Osbahr DC. High risk stress fractures: evaluation and treatment. *J Am Acad Orthop Surg* 2000; 8:344-353.
- 3. Shindle MK et al. Stress fractures about the tibia, foot, and ankle. *J Am Acad Orthop Surg* 2012; 20:167-176.



continued on page 10

Question 6

A 13 year old little league pitcher presents with a history of pain after throwing for 6 weeks. Physical exam shows a slight flexion contracture and slight tenderness over the lateral distal humerus. Radiographs and MRI are below. The best initial treatment course should consist of:

- A. Activity restriction and range of motion exercises
- B. Long arm cast for 12 weeks
- C. Open drilling of the lesion
- D. Arthroscopic drilling and fixation
- E. Microfracture

Answer: A

Management of OCD of the capitellum is controversial because the healing potential and natural history of these lesions is poorly understood. Treatment is based primarily on the integrity of the articular cartilage surface and the stability of the lesion. Conservative treatment is selected for patients with early grade, stable lesions, and it involves activity modification, i.e 3 to 6 weeks of rest followed by return to sport in 3 to 6 months. Range of motion exercises may be helpful when pain subsides. Radiographic healing lags behind clinical improvement, so symptom relief should be used as a guide for return to sports. Young patients with open growth plates may have a better chance to heal.

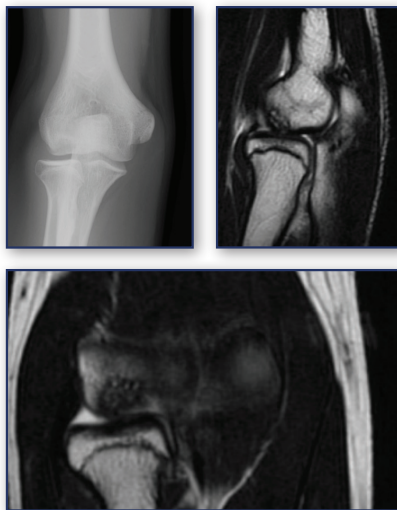
Surgical indications include the presence of loose bodies, mechanical symptoms, radiographically unstable lesions, and stable lesions that have failed 6 months of nonsurgical management. Surgical goals include stimulation of the healing response and stabilization of unstable fragments. Surgical options include arthroscopic, as well as formal arthrotomy, for the excision of loose

bodies, fragment excision, abrasion arthroplasty, drilling, microfracture, fragment fixation, bone grafting, osteotomy, or osteochondral autograft transplantation (OAT).

In this radiographically stable lesion, the best initial treatment is activity modification.

References:

1. Kobayashi K, Burton KJ, Rodner C, Smith B, Caputo AE: Lateral compression injuries in the pediatric elbow: Panner's disease and osteochondritis dissecans of the capitellum. *J Am Acad Orthop Surg* 2004;12(4):246-254.
2. Mihara K, Tsutsui H, Nishinaka N, Yamaguchi K: Nonoperative treatment for osteochondritis dissecans of the capitellum. *Am J Sports Med* 2009;37(2):298-304
3. Ruchelsman DE, Hall MP, Youm T. Osteochondritis dissecans of the capitellum: current concepts. *J Am Acad Orthop Surg*. 2010 Sep;18(9):557-67.



Question 7

A six year old boy presents with pain in his knee and limping. There is no history of trauma. Physical exam shows no effusion or instability.

There is a clicking sensation with McMurray's test. Radiographs are normal. The MRI is below. Treatment should include:

- A. Meniscal transplant
- B. Drilling and fixation of the osteochondral fragment
- C. Partial meniscectomy
- D. Total meniscectomy
- E. Extraphyseal anterior cruciate reconstruction

Answer: C

This patient has a discoid meniscus. A discoid meniscus can exist as an asymptomatic stable structure, or may be torn and/or unstable. The meniscus may extend over the entire plateau, or may be thicker than normal with a small medial opening. Diagnosis is based upon MRI. On a sagittal view, a meniscus that fails to separate into anterior and posterior horns after the third "slice" toward the midline is a discoid meniscus. Coronal views may be helpful as well, as in the case above.

For menisci that are only attached to the capsule by the ligament of Wrisberg, the patient will often present with popping symptoms. Treatment consists of saucerization (recreating a more normal meniscal shape through a partial meniscectomy) and repair of the meniscus to the capsule. In stable cases, the friable medial tissue causes symptoms after it tears, and simple saucerization may be successful. Total meniscectomy should be avoided if possible, and incidentally found discoid menisci do not require treatment.

References:

1. Oğüt T, Kesmezacar H, Akgün I, Cansü E: Arthroscopic meniscectomy for discoid lateral meniscus in children and adolescents: 4.5 year follow-up. *J Pediatr Orthop B* 2003; 12:390-397

2. Good CR, Green DW, Griffith MH, Valen AW, Widmann RF, Rodeo SA: Arthroscopic treatment of symptomatic discoid meniscus in children: Classification, technique, and results. *Arthroscopy* 2007; 23:157-163. PMID:17276223
3. Kim JM, Bin SI: Meniscal allograft transplantation after total meniscectomy of torn discoid lateral meniscus. *Arthroscopy* 2006;
4. Micheli LJ, Kramer DE. Meniscal Tears and Discoid Meniscus in Children: Diagnosis and Treatment *J Am Acad Orthop Surg* November 2009 vol. 17 no. 11 698-707



Question 8

13 year old female sustains an injury to her left knee while in gym class five days prior to presentation. She planted her left leg, twisted and felt a pop. She was able to ambulate but with difficulty, and has had significant swelling since the injury. She has been in a knee immobilizer and on crutches since the injury. Physical examination reveals a significant knee effusion; she has full extension of her knee but limited flexion secondary to the effusion. Arthrocentesis of the knee reveals a lipohemarthrosis. Xrays and MRI are shown below:

What is the treatment of choice?

- A. Physical Therapy with gradual return to activity.

- B. Diagnostic arthroscopy with treatment of osteochondral fracture and medial retinacular plication.
- C. Diagnostic arthroscopy with lateral release only.
- D. Diagnostic arthroscopy, lateral release and medial retinacular plication.

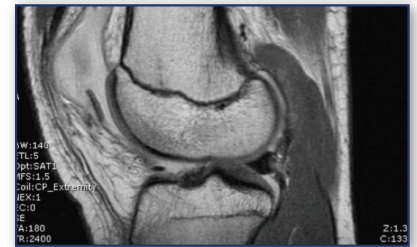
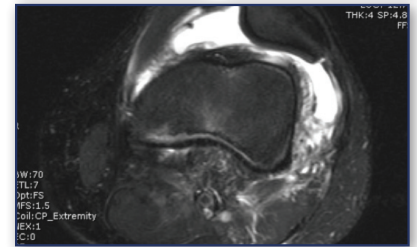
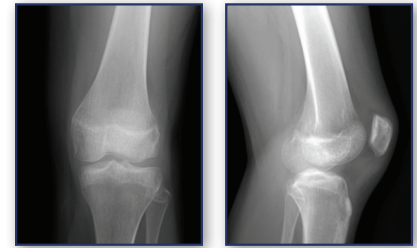
Answer: B

The MRI demonstrates evidence of a transient patellar dislocation with a lateral femoral condylar osteochondral fracture and partial tearing of the medial patellar retinaculum. Acute patellar dislocations are the most common cause of lateral femoral condyle osteochondral fractures. It is important to remember that in the pediatric patient, knee injuries that present with an effusion have a high rate of underlying pathology. Radiographs are important to rule out physeal fractures, while an MRI can help identify ACL tears, meniscal injuries and osteochondral fractures.

Once the patient is found to have an osteochondral fracture, treatment is most often surgical, unless the fracture is stable with an intact cartilage surface. Loose osteochondral fractures are treated with diagnostic arthroscopy, joint lavage and repair of the osteochondral fracture if possible. If the osteochondral fracture is not repairable, other options can be considered such as microfracture, autograft plugs, ACL, etc... After the osteochondral fracture has been addressed, a patellar stabilization procedure can be performed as appropriate.

References:

1. Kramer DE. , Pace JL. Acute Traumatic and Sports-Related Osteochondral Injury of the Pediatric Knee. *Orthop Clin N Am* 43 (2012)227-236.



Question 9

In the high school population, which group of athletes has the highest incidence of ACL injuries:

- A. Football players in competition
- B. Female soccer players
- C. Male soccer players
- D. Female basketball players
- E. Male basketball players

Answer: B

References:

1. Shea KG, et al. Youth Sports Anterior Cruciate Ligament and Knee Injury Epidemiology: Who is Getting Injured? In What Sports? When? *Clin Sports Med* 30(2011)691-706.
2. While football players have the highest incidence of injury rates overall (as high as 8.1 per 1000 exposures), female soccer players continue to have the highest

continued on page 12

number of ACL injuries (14.08 per 100,000 athletic exposures). This is according to the National High School Sports-Related Injury Surveillance Study. Basketball has the highest proportion of ankle injuries for both boys and girls, while girls' basketball had the second highest ACL incidence to girls' soccer.

Question 10

A 13+6 year old female sustains a complete ACL tear. She is premenarchal with a bone age of 13. Which of the following techniques may decrease the risk of the growth arrest or angular deformity during transphyseal ACL reconstruction?

- A. High speed reaming of the transphyseal tunnel
- B. Peripheral placement of the transphyseal tunnel
- C. Undersizing the bone-tendon-bone graft
- D. Use of endobutton fixation in the femur
- E. Fixing the tibial graft anterocentrally

Answer: D

Transphyseal ACL reconstruction has excellent functional outcomes with the benefit of an anatomic repair in the post-pubescent, skeletally immature adolescent. This can be

accomplished with a very low rate of growth arrest or angular deformity due to physeal injury or premature closure. The ideal technique involves central placement of femoral and tibial tunnels across the physis with slow, pulsed reaming of the physis to avoid thermal necrosis. Autograft and allograft have been used with equal efficacy, with fixation that spares the physis and the tibial tubercle apophysis (ie. femoral endobutton and metaphyseal screws, washers, pins in the tibia). Bone-tendon-bone grafts have a theoretical risk of causing a physeal bar.

Question 11

A 14 year old female soccer player sustains a sprain of the anterior talofibular ligament of her right ankle. After four weeks of activity restriction, boot immobilization, ice, oral NSAIDs, and home exercises her pain is unchanged. You prescribe physical therapy. After 4 weeks of physical therapy, she still has pain and it is more diffuse over the ATFL, dorsum of foot, and distal tibia. An MRI of the ankle shows a resolving grade 1 sprain of the ATFL. A Tc99 bone scan shows mild, diffuse increased uptake in the distal tibia. At this point, you should

- A. Schedule ankle arthroscopy for anterolateral impingement
- B. Consult hematology / oncology

- C. Obtain CBC, ESR to evaluate for occult infection
- D. Continue physical therapy and consider additional pharmacotherapy
- E. Apply a walking cast for chronic stress fracture

Preferred Answer: D

Mild ankle sprain is a common trigger for Amplified Musculoskeletal Pain Syndrome or AMPS (previously called Complex Regional Pain Syndrome or Reflex Sympathetic Dystrophy). This disorder of the nervous system results in chronic pain that is greater in intensity, duration, and distribution than the pain of the trigger event. Patients may have allodynia (pain to light touch), skin color changes, and cold intolerance. Plain films may show relative osteopenia as the condition progresses. Tc99 bone scan may show diffuse periarticular increase in uptake. Treatment consists of physical therapy and avoidance of immobilization. The expectation should be a prolonged course of 3-6 months or longer. Pharmacotherapy with GABA-ergic medications (gabapentin, pregabalin) may be a useful adjunct. Stellate ganglion blocks and spinal cord stimulation have been used with success in recalcitrant cases.

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Choosing a fellowship is an important step in one's career. The AAOS Board of Specialty Societies (BOS) Match Oversight Committee webinar: "**Tips for the Orthopaedic Fellowship Match**" is now available online. Learn the history of the match, helpful match statistics from each subspecialty match, tips from program directors and information on what to look for in choosing a fellowship. The webinar was hosted by Lisa Cannada, MD, Chair of the BOS Match

Oversight Committee, and the webinar faculty included Fellowship Directors, a representative from San Francisco Matching Program and recent participants in the match process!

Match Program Participation Data from the past three matches (2010 – 2012) is also available online. This information, mentioned in the webinar, will be helpful as you plan your fellowship application process. —

Question 12

11 year old female presents with a several month history of left knee pain. She has had no history of trauma. She plays soccer year round, as well as basketball and runs track. Her pain is worse with activity and rarely present at rest. On physical exam she has no effusion and her ligamentous exam is stable. What radiographic view would be most helpful in establishing her diagnosis ?

- A. CT scan
- B. Merchant view in 30 degrees of flexion
- C. Notch view with the knee flexed 30-50 degrees
- D. AP and frog lateral pelvis
- E. Bone scan

Preferred Response: C

The most common site for osteochondritis dissecans lesions is the medial femoral condyle. Recommended radiographs include weight bearing AP, lateral and notch (tunnel) views of the knee. The notch view also has the highest inter-rater reliability when determining OCD healing. Further imaging with MRI is helpful in determining stability of the lesion.

References:

1. Parikh SN, Allen M, Wall EJ, May MM, Laor T, Zbojniewicz AM, Eismann EA, Myer GD. The reliability to determine "healing" in osteochondritis dissecans from radiographic assessment. *J Pediatr Orthop.* 2012 Sep;32(6):e35-9.



Question 13

The width of the intercondylar notch as a risk factor for ACL injury in the skeletally immature patient can best be described as:

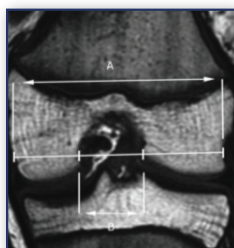
- A. The width of the intercondylar notch has no relation to the risk for ACL tear in the skeletally immature patient
- B. A wide intercondylar notch has been associated with an increased risk for ACL tear in the skeletally immature patient
- C. Gender and mechanism of injury are more predictive of ACL tear than the width of the intercondylar notch.
- D. A narrow intercondylar notch is associated with an increased risk for ACL tear in the skeletally immature patient.
- E. The width of the intercondylar notch has no association with risk for ACL tear in the skeletally immature athlete.

Preferred Response: D

A decreased intercondylar notch size is associated with an increased risk of suffering ACL injury-in the skeletally immature patient.

References:

1. Risk factors for Anterior Cruciate Ligament injury in skeletally immature patients: analysis of intercondylar notch width using Magnetic Resonance Imaging *Int Orthop.* 2010 June;34(5):703-707.



Question 14

Symptomatic meniscal cysts found in association with meniscal tears in adolescents should be treated with the following intervention:

- A. Aspiration and injection with anticipated resolution
- B. No treatment
- C. Arthroscopic debridement through the meniscal tear with meniscal repair
- D. Meniscectomy
- E. Open exploration, ligation and excision of the cyst.

Preferred Response: C

While traditional management of meniscal cysts was open exploration and excision, more recent studies support arthroscopic debridement through the tear, followed by meniscal repair. Meniscal cysts are more commonly found in association with lateral meniscal tears in the adolescent athlete. Aspiration and injection does not result in resolution of the cyst, and preservation of the meniscus is recommended in young patients.

References:

1. Ryu RK, Ting AJ: Arthroscopic treatment of meniscal cysts. *Arthroscopy* 1993;9:591-595.

Question 15

Reported complications following ACL reconstruction the skeletally immature athlete include all of the following except:

- A. Arthrofibrosis
- B. Asymptomatic physeal arrest
- C. Genu valgum
- D. Limb length inequality
- E. Genu procurvatum

Preferred Response: E

continued on page 14

Reconstruction of the ACL in skeletally immature athletes is gaining in popularity due to the sequelae of nonoperative treatment, with irreparable chondral injury and meniscal tears occurring more commonly. A number of complications have been reported including physeal arrest resulting in LLD, overgrowth and genu valgum. Tibial recurvatum (not procurvatum) has been reported after injury to the tibial tubercle apophysis. Arthrofibrosis has also been reported as a complication of both ACL reconstruction and tibial eminence fixation in skeletally immature patients.

References:

1. Kocher MS, Saxon HS, Hovis WD, Hawkins RJ: Management and complications of anterior cruciate ligament injuries in skeletally immature patients: Survey of the Herodicus Society and the ACL Study Group. *J Pediatr Orthop* 2002;22:452-457.
2. Makela EA, Vainionpaa S, Vihtonen K, Mero M, Rokkanen P: The effect of trauma to the lower femoral epiphyseal plate: An experimental study in rabbits. *J Bone Joint Surg Br* 1988; 70:187-191
3. Nwachukwu BU, McFeely ED, Nasreddine A, Udall JH, Finlayson C, Shearer DW, Micheli LJ, Kocher MS. Arthrofibrosis after anterior cruciate ligament reconstruction in children and adolescents. *J Pediatr Orthop*. 2011 Dec;31(8):811-7.

Question 16

To minimize the risk of growth disturbance following ACL reconstruction in the skeletally immature patient, all of the following precautions should be taken except:

- A. Peripheral bone tunnels
- B. Small bone tunnels (< 7 mm)
- C. Avoid dissection around the tibial tubercle and femoral perichondrial ring
- D. Fill tunnels with soft tissue graft
- E. Excessive graft tensioning

Preferred Response: A

A number of studies in animals have been performed looking at the effects of transphyseal drilling. Small, central (not peripheral) bone tunnels filled with soft tissue graft have been shown to be safe for the physis. Dissection around the perichondrial ring of the distal femur or tibial tubercle results in physeal arrest. Excessive graft tensioning can also lead to physeal closure.

References:

1. Edwards TB, Greene CC, Baratta RV, Zieske A, Willis RB: The effect of placing a tensioned graft across open growth plates: A gross and histologic analysis. *J Bone Joint Surg Am* 2001;83:725-734
2. Janarv PM, Wikstrom B, Hirsch G: The influence of transphyseal drilling and tendon grafting on bone growth: An experimental study in the rabbit. *J Pediatr Orthop* 1998;18:149-154.

Question 17

A 14 year old female was playing soccer and sustained a non-contact knee injury. She had immediate effusion and further physical examination showed a positive Lachman's test and Anterior Drawer Sign. What are the odds of this patient getting an appointment with an orthopaedic surgeon when she is privately insured versus if she were to have Medicaid insurance?

- A. 8 times
- B. 38 times

- C. 57 times
- D. 90 times

Answer: C

Pediatric patients with Medicaid insurance have a significant barrier to care. This is especially true for orthopaedic conditions. Multiple studies have demonstrated a lack of accessibility of pediatric patients with simple fractures. This has also worsened over time. ACL tears are no exception. Pierce et al demonstrated, via fictitious patient phone calls, that a privately insured pediatric patient would be seen in 90% of the practices contacted vs 14% if that same patient was described as having Medicaid (an odds ratio of 57).

References:

1. Pierce TR, Mehlman CT, Tamai J, Skaggs DL. Access to care for the adolescent anterior cruciate ligament patient with Medicaid versus private insurance. *J Pediatr Orthop*. 2012 Apr-May;32(3):245-8.
2. Sabatini CS, Skaggs KF, Kay RM, Skaggs DL. Orthopaedic surgeons are less likely to see children now for fracture care compared with 10 years ago. *J Pediatr*. 2012 Mar;160(3):505-7.

Question 18

A 12 year old boy presents with a 6 month history of foot pain. This is especially painful when he participates in baseball. He describes the pain as dull and achy and his mother says that she has kept him out of participating and that has eased the symptoms somewhat. On physical examination, he is directly tender to palpation over his heel at insertion of the Achilles tendon. What is the next step in your management?

- A. MRI of foot
- B. Plain X-ray of foot (AP and Lateral)

- C. Achilles stretching, activity modifications, and symptomatic treatment
- D. Short leg walking cast
- E. Long leg casting.

Answer: C

Plain radiographic evaluation nor MRI has been helpful in the diagnosis of Sever's disease (osteochondrosis of the calcaneal apophysis). Casting has been used only after a trial of stretching and activity modifications have failed. Stretching and symptomatic treatment with cushioned heel cups can modify symptoms until fusion of the apophysis.

References:

1. Kose O, Celiktas M, Yigit S, Kisin B. Can we make a diagnosis with radiographic examination alone in calcaneal apophysitis (Sever's disease)? *J Pediatr Orthop B.* 2010 Sep;19(5):396-8.

Question 19

A 13-year-old female soccer player sustains a non-contact injury resulting in a complete tear of her anterior cruciate ligament (ACL). She wishes to resume soccer next season. You advise her that:

- A. An ACL-stabilizing brace will allow her to safely continue training until she is skeletally mature and can undergo ACL reconstruction surgery.
- B. A physeal-sparing "over the top" technique using iliotibial band autograft is the treatment of choice in her age group.
- C. Bone-tendon-bone autograft is recommended because it is the gold standard graft for ACL reconstructions and offers the best outcomes with the least amount of risk.

- D. Hamstring autograft reconstruction with anatomically placed tunnels is appropriate.
- E. An all-epiphyseal hamstring autograft should be performed because it poses no risk to her growth plates.

Correct answer: D

ACL tears in skeletally immature patients are increasing in prevalence and have been the subject of numerous studies. Contact (direct blow to the knee) or non-contact (pivot of the knee while landing or cutting) mechanisms can result in disruption of the ACL as well as associated injuries to the menisci, cartilage, and/or other ligaments. Non-operative treatment can result in recurrent episodes of instability causing additional damage, and strict activity modification is difficult to enforce in a young, active population. Reconstruction of the ACL-deficient knee is usually recommended prior to allowing patients to return to sports; however, graft placement risks damage to open physes in young children. Bone-tendon-bone grafts place the physes at greatest risk and are not recommended in patients with any growth remaining. Physeal-sparing techniques have been developed and, although technically difficult, are gaining popularity in the very young prepubescent population. Adolescents such as this 13-year-old female fall into a category between skeletal maturity and the very young, and, although possible, physeal damage is unlikely to result in growth arrest or deformity. Patients in this age group, therefore, are good candidates for ACL reconstructions with soft tissue grafts such as hamstring autografts.

References:

1. Frank JS, Gambacorta PL: Anterior cruciate ligament injuries in the skeletally immature athlete:

diagnosis and management. *J Am Acad Orthop Surg.* 2013 Feb;21(2):78-87.

2. Kocher MS, Saxon HS, Hovis WD, Hawkins RJ: Management and complications of anterior cruciate ligament injuries in skeletally immature patients: survey of the Herodicus Society and The ACL Study Group. *J Pediatr Orthop.* 2002 Jul-Aug;22(4):452-7.
3. Lawrence JTR, West RL, Garrett WE: Growth disturbance following ACL reconstruction with use of an epiphyseal femoral tunnel: a case report. *J Bone Joint Surg Am,* 2011 April 20;93(8).

Question 20

Meniscal injuries have been associated with anterior cruciate ligament (ACL) tears in the pediatric population. Which of the following statements is true?

- A. Medial meniscal injuries occur more frequently than lateral meniscal injuries at the time of ACL tears.
- B. Lateral meniscal injuries occur frequently at the time of the ACL injury; whereas the incidence of medial meniscal injuries increases if ACL reconstruction is delayed.
- C. The risk of lateral meniscal injury increases significantly if ACL reconstruction is delayed greater than 6 weeks.
- D. Chondral injuries are more likely to occur in the opposite compartment as the meniscal tear.
- E. In patients with open growth plates, meniscal injuries should be repaired as soon as possible to prevent degenerative arthritis; whereas, ACL reconstruction should be delayed until skeletal maturity.

Correct answer: B

continued on page 16

Meniscal injuries can occur in isolation or with associated injuries such as ACL tears. In a review of 370 pediatric patients who underwent primary ACL reconstruction, Dumont et al found lateral meniscal tears in 56.0% of those treated within 150 days of injury and 57.4% of those treated after 150 days. Medial meniscal tears were found in 37.8% and 53.5%, respectively. Chondral injuries were significantly associated with meniscal injuries in the same compartment. Lawrence et al also found that delaying ACL reconstruction in children is associated with increased rate and severity of medial meniscal tears.

References:

1. Dumont GD, Hogue GD, Padalecki JR, Okoro N, Wilson PL: Meniscal and chondral injuries associated with pediatric anterior cruciate ligament tears: relationship of treatment time and patient-specific factors. *Am J Sports Med.* 2012 Sep;40(9):2128-33.
2. Lawrence JT, Argawal N, Ganley TJ: Degeneration of the knee joint in skeletally immature patients with a diagnosis of an anterior cruciate ligament tear: is there harm in delay of treatment? *Am J Sports Med.* 2011 Dec;39(12):2582-7.

Question 21

Which factor is most important for predicting healing potential of meniscal tears?

- A. Age of patient at time of injury
- B. Distance of tear from peripheral rim
- C. Medial versus lateral meniscus
- D. Time from injury to surgery
- E. Surgical technique: inside out versus all inside

Correct answer: B

The vascular anatomy is very important in predicting the healing potential of meniscal tears. Vessels originate in the perimeniscal capsule and synovial tissue and penetrate into the peripheral meniscus resulting in a vascularized rim (red-red zone), a less vascularized middle zone (red-white zone) and an avascularized central portion (white-white zone). Although surgical technique may affect the stability of the repaired tissue, actual healing is dependent on vascular ingrowth. Meniscal tears associated with anterior cruciate ligament reconstructions have been shown to have improved healing rates and may be due to the increased vascular response associated with the injury and/or surgical trauma.

Children have been shown to heal or partially heal tears in avascular zones, and some advocate repairing all tears citing that, even with failed repairs, the amount of subsequent meniscectomy is rarely increased when compared with the original lesion.

References:

1. Arnoczky SP, Warren RF: The microvasculature of the meniscus and its response to injury. An experimental study in the dog. *Am J Sports Med.* 1983 May-June;11(3):131-41.
2. Kraus T, Heidari N, Svehlik M, Schneider F, Speri M, Linhart W: Outcome of repaired unstable meniscal tears in children and adolescents. *Acta Orthop.* 2012 Jun;83(3):261-6.
3. Pujol N, Barbier O, Boisrenoult P, Beaufils P. Amount of meniscal resection after failed meniscal repair. *Am J Sports Med.* 2011 Aug;39(8):1648-52.
4. Pujol N, Panarella L, Selmi TA, Nevret P, Fithian D, Beaufils P: Meniscal healing after meniscal repair: a CT arthrography assessment. *Am J Sports Med.* 2008 Aug 36(8):1489-95. ■

Committee Appointment Program

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