

Knee Injuries in the Growing Athlete

Guideline developed and finalized 02/09/17 by Brant Sachleben, MD, in collaboration with the ANGELS Team.

Key Points

- Sports-related injuries in young athletes are increasing.
- Approximately 95% of acute knee injuries with a hemarthrosis have evidence of an intraarticular injury (eg, anterior cruciate ligament tear, meniscus tear, patellar dislocation).
- Magnetic resonance imaging (MRI) should be the next step in an athlete with a combination of an acute knee injury, a hemarthrosis, or new onset knee effusion and negative radiographs.
- Non-operative treatment of complete anterior cruciate ligament (ACL) tears in young athletes results in significant increases in irreparable injuries to other structures in the knee.
- ACL reconstructions can be done safely in growing athletes and should be growth-plate-respecting surgeries.

Introduction

Incidence

- Sports-related injuries in the growing athlete are increasing.
 - 3.5 million athletes <14 years of age are treated for sports-related injuries each year.
 - Children 5 to 14 years of age account for 40% of all sports-related injuries treated in hospital emergency departments.
- ACL injuries, once rare among children and growing athletes, are becoming more common.
- The incidence of meniscal tears has increased in recent years.

Contributing Factors

- More children are participating in sports than ever before. In 2011, there were 38 million young athletes involved in organized sports.
- The culture of youth sports has changed dramatically in the past few decades.

- Youth sports can be very competitive; the young athlete may feel pressure to perform at a high level.
- Many young athletes now focus on a single sport instead of playing several sports.
- The opportunity for free play is less.

Paradigm Shift in Evaluation and Treatment

- Evaluation and treatment of youth sports injuries have changed.
- Previous beliefs were that “kids don’t tear their ACLs; kids don’t tear their menisci; just put them in a cast and they will heal.”
- These beliefs are not true. Kids do tear their ACLs, and they do tear their menisci.
- Knee injuries in children require specialized treatment.

Definitions

Common types of knee injuries leading to an acute traumatic hemarthrosis seen in the growing athlete include

- Ligament tear
- Meniscal injury
- Patellar dislocation
- Intraarticular fracture or bone bruise, including chondral injury

Ligament Tear

- The ACL is a major stabilizer for activities that require cutting and pivoting, including both competitive sports and playing tag on the playground
- Once ruptured, the ligament does not heal or regenerate because the blood supply is also lost at the time of injury.
- Although less common, other major ligaments of the knee which also can tear are the
 - Posterior cruciate ligament (PCL)
 - Lateral collateral ligament (LCL)
 - Medial collateral ligament (MCL)

Meniscal Injury

- The medial and lateral meniscus provides stability and shock absorption to the knee. They also help distribute the force within the knee
- There is a high incidence of meniscal tears associated with ACL ruptures
- In children *with* an acute traumatic hemarthrosis of the knee, meniscal tears have been found in 47% of those knees in children 7 to 12 years of age and 45% of those knees in adolescents 13 to 18 years of age.

Patellar Dislocation

- The patella lives within the trochlea of the femur. It functions to improve the mechanical efficiency of the extensor mechanism
- Dislocations typically occur secondary to a twisting mechanism leading to lateral translation of the patella over the lateral femoral condyle.
- First time dislocations usually occur in adolescent high-level athletes from a combination of musculotendinous tightness and relative ligamentous laxity in the setting of a pivoting activity.
- Incidence is equal in males and females.

- Anatomic predispositions play a greater role in risk of recurrence

Intraarticular Fracture or Bone Bruise

- Intraarticular fractures occur when the fracture line of the distal femur or proximal tibia exits into the knee joint.
- Osteochondral fractures are versions of intraarticular fractures that lead to damage of the cartilage and associated bone. These may result in loose bodies within the knee.
- Isolated chondral injury is rare; it typically occurs in combination with an ACL tear or patellar dislocation.

Assessment and Diagnosis

History

Include the following key questions when obtaining the history ([Table 1](#)).

Table 1. Key Questions for Knee Injury History

To view a larger image on your device, please click or touch the image.

Table 1. Key Questions for Knee Injury History

1	How did the injury happen (ie, mechanism of injury)?
2	Did the child feel or hear a pop?
3	Was there immediate or near immediate swelling of the knee joint? (Presence of swelling is a very important key to the history and indicates the need for further investigation.)
4	Has the child had previous knee injuries?
5	Was the child able to re-enter the game or event? If yes, how did the knee feel?

Physical Examination

Preliminary Examination

- Some knee exam maneuvers can displace a fracture. So if you suspect a fracture, do a preliminary survey-type examination then order radiographs.
- Once a fracture is ruled out, you can do a more extensive exam.

Inspection

- Inspect for deformity, bruising, and presence of effusion/hemarthrosis.
 - An easy way to identify effusion is loss of medial knee dimple with the knee flexed at or near 90°.
 - The presence of an acute effusion or hemarthrosis after knee injury suggests significant intraarticular knee pathology in 95% of cases.
- Look for signs of the following:

- Ligament tear (acute hemarthrosis indicates a complete or partial ACL tear in two-thirds of all cases)
- Meniscal injury
- Patellar dislocation
- Intraarticular fracture or bone bruise, including chondral injury

Palpation

Palpate for presence of tenderness on the bony point and joint line.

Special Tests

The following special tests may be used to aid diagnosis. [Click here](#) for a showing how to perform the Lachman test and anterior drawer test.

- Lachman test
 - Flex knee to 20°-30°, grasping femur with one hand and the proximal tibia with the other. Shift the hand with the tibia anteriorly. [Click here](#) for a video demonstration.
 - Positive if no endpoint
- Anterior drawer test
 - Flex the knee to 90°. Place both hands on the proximal tibia and pull anteriorly. [Click here](#) for a video demonstration.
 - Positive if no endpoint
- Lateral patellar apprehension test
 - Presence of joint line tenderness to palpation may indicate possible meniscal pathology.
 - Gently shift patella laterally to check endpoint or apprehension. [Click here](#) for a video demonstration.

Imaging Studies

Radiographs

- Obtain at least anterior-posterior (AP) and lateral views if radiography is indicated.
- Radiographs are used to diagnose or rule out a fracture about the knee which is still more common in children than ligamentous injuries.

Magnetic Resonance Imaging

Obtain an MRI for any acute knee injury with an effusion or hemarthrosis and negative radiographs.

Management and Treatment Recommendations

Anterior Cruciate Ligament Injuries

- Historically, treatment of ACL tears in the growing athlete revolved around activity modification and bracing until skeletal maturity. Multiple studies show poor outcomes when ACL ruptures are treated in this manner.
 - Children treated non operatively may be unable to return to sport due persistent knee instability
 - Children who receive delayed surgical treatment for ACL tears have a significant increase in *irreparable* injuries to the other structures within the knee.
- Surgical reconstruction should be growth-plate respecting in patients with open growth plates.

- Growth plates close on average for males at 16 years of age and for females at 14 years of age.
- Treatment of ACL tears in patients younger than this and in those that are still growing require specialized management that respects the growth plate.
- Some minor risk to the growth plate is possible but it is less than the risk to the meniscus and cartilage associated with treating the ACL tear without surgery

Other Conditions and Injuries

Refer to [Table 2](#) for management and treatment recommendations.

Summary

[Table 2](#) summarizes assessment, diagnosis, and management of knee injuries in the growing athlete. The [Figure](#) provides guidance in evaluating injuries to the knee in a growing athlete.

Table 2. Assessment, Diagnosis, and Management of Knee Injuries in the Growing Athlete

To view a larger image on your device, please click or touch the image.

Table 2. Assessment, Diagnosis, and Management of Knee Injuries in the Growing Athlete

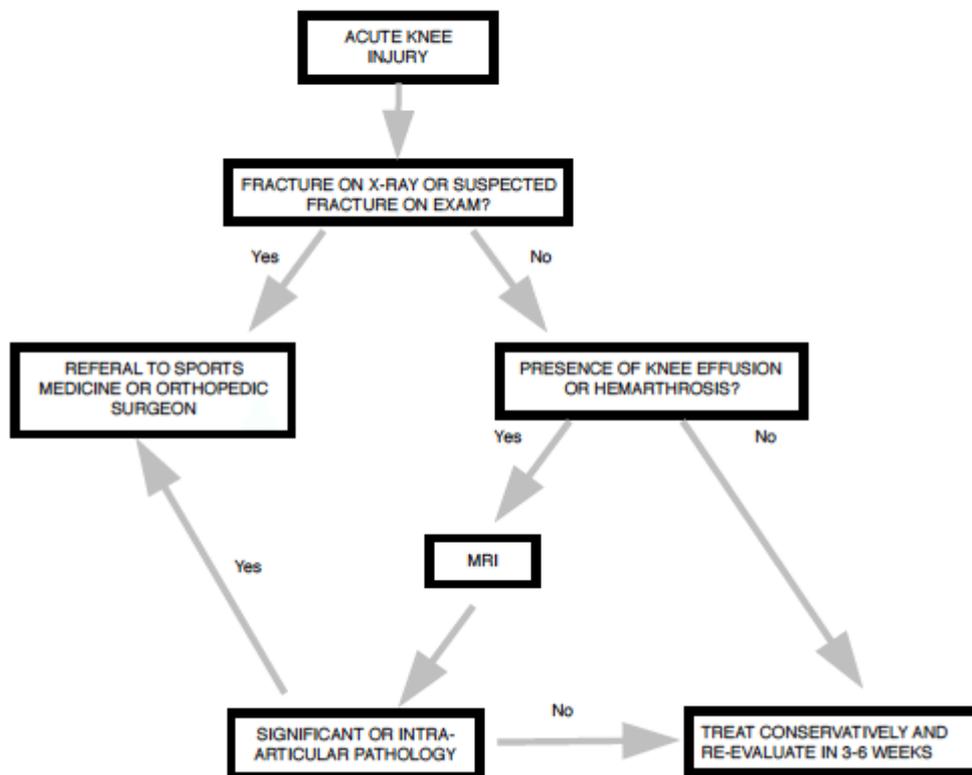
	History	Examination	Imaging Studies	Management
ACL tears	<ul style="list-style-type: none"> • Twisting non contact knee injury or direct blow to the knee • Near immediate effusion 	<ul style="list-style-type: none"> • Knee effusion if evaluated acutely • Increased laxity on Lachman testing 	<ul style="list-style-type: none"> • Radiographs often negative • MRI will show ACL rupture 	<ul style="list-style-type: none"> • Surgical treatment for complete ACL tears is standard of care in proper surgical candidates • Recommend early diagnosis and referral to a sports medicine orthopedic surgeon who is comfortable treating ACL tears in patients with open growth plates
Meniscal tears	<ul style="list-style-type: none"> • Usually a twisting knee injury • Effusion comes later than ligamentous injury effusion (~24 hours) 	<ul style="list-style-type: none"> • Exam difficult in children • Joint line tenderness with an acute effusion or hemarthrosis is a worrisome sign 	<ul style="list-style-type: none"> • Radiographs often negative • MRI will show meniscal injury 	<ul style="list-style-type: none"> • Early referral to orthopedics or sports medicine if MRI is positive
Patella dislocation	<ul style="list-style-type: none"> • Painful, swollen knee • Feeling of knee giving way • Typically lateral but patient may think the patella went medial 	<ul style="list-style-type: none"> • Increased lateral laxity of the patella and apprehension of the patient when testing lateral laxity 	Radiographs <ul style="list-style-type: none"> • AP, lateral, tunnel, and sunrise • Verify reduction • MRI will determine extent of chondral injury 	<ul style="list-style-type: none"> • Recommend early diagnosis and referral to a sports medicine orthopedic surgeon if significant bony or cartilaginous injury • If no significant bony or cartilaginous injury, first-time dislocations can be managed conservatively • Repeat instability should be referred
Chondral injury	<ul style="list-style-type: none"> • Painful, swollen knee • May complain of the knee "getting stuck" 	<ul style="list-style-type: none"> • Knee effusion • May have tenderness directly over the medial or lateral femoral condyles with the knee in flexion 	<ul style="list-style-type: none"> • 40% of chondral injuries missed on plain radiograph • MRI can detect pure chondral injuries 	<ul style="list-style-type: none"> • Chondral injury requires early referral to orthopedic specialist

Abbreviations: ACL, anterior cruciate ligament; AP, anterior-posterior; MRI, magnetic resonance imaging.

Figure. Evaluation of knee injuries in the growing athlete.

To view a larger image on your device, please click or touch the image.

Figure. Evaluation of knee injuries in the growing athlete.



Prevention

- All knee injuries cannot be prevented but promising results have been shown when ACL tear prevention programs have been implemented.
 - A randomized study of 1400 athletes showed a 40% decrease in ACL tear rates and 70% decrease in non contact ACL tear rates as a result of an ACL tear prevention program.
 - [Click here](#) for an example of an ACL tear prevention program.

Resources

- Sports Injury Prevention PEP Program: <http://smsmf.org/smsf-programs/pep-program>
- [Injury Prevention Resources for Athletes, Coaches, Healthcare Providers, and Parents](#)
- [Sports Safety 101](#)

This guideline was developed to improve health care access in Arkansas and to aid health care providers in making decisions about appropriate patient care. The needs of the individual patient, resources available, and limitations unique to the institution or type of practice may warrant variations.

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