

# Overuse injuries in children

Pr Aurélien Courvoisier

Department of Pediatric Orthopedics  
Couple/Child Hospital  
Grenoble Alpes University Hospital

## Introduction

In its most classic definition, an overuse injury is a chronic injury due to a high level of physiological load exerted on the musculoskeletal system without allowing ample amount of rest between training sessions [1,2]. As a result, a quantified amount of overuse cannot be specifically defined for the entire pediatric population.

There has been a recent increase in overuse injuries in children, injuries which are often ignored or trivialized and are categorized as “growing pains”. However, growth is not painful and musculoskeletal pathologies are responsible for the pain, an invalidating complaint for many children. These pains are especially aggravated during pubertal growth spurts when the lower limbs develop too quickly and the entire musculoskeletal system is overloaded [3].

This chapter will mostly focus on sports-related injuries, even though overuse injuries may occur in children who practice little to no sports. Even non-athletic children complaining of chronic pains that are typical of these types of injuries frequently seek medical attention.

Instead of simplifying the issue as one affecting hyperactive athletic children in general, it would be preferable to compare it to a mismatch between “supply”, i.e. the musculoskeletal system’s ability to cope with a given activity over a certain period of time during growth, and “demand”, i.e. the intensity, frequency, and duration of one or multiple activities; It should be noted that, in certain children, merely activities of daily living may be considered as physical activity.

The most common overuse injuries of one or multiple extremities will be discussed in this chapter while concentrating on the more typical sports-related injuries. In order to simplify the presentation, reasons for consultation will be discussed first, i.e. pain in either the lower or upper limbs.

## Lower limb pain

Pain located at the knee or tibia is a frequent complaint in preadolescent children seeking medical attention. The most common overuse injuries include:

- Osgood-Schlatter disease
- Sinding-Larsen-Johansson syndrome

These two entities represent 18% of all causes of overuse injuries in the pediatric population and form part of the grand family of osteochondroses [4].

Osgood-Schlatter disease is defined as chronic inflammation of the patellar tendon at its insertion on the tibial tuberosity. In its most frequent form, Osgood-Schlatter disease affects girls between 8 and 13 years old and boys between 10 and 15 years old and is the primary ailment suffered in France by boys engaging in professional football (soccer) [5]. While striking the ball, the quadriceps is locked, the knee is in full extension, and the entire extensor mechanism is stressed. Pain, in the absence of appropriate management, may become invalidating to the point of preventing the child from participating.

The typical clinical presentation includes pain during physical activity, tenderness, and, in its more severe forms, swelling and erythema at the level of the tibial tuberosity. Conventional radiographs are often normal; fragmentation of the secondary ossification center of the tibial tuberosity is a normal finding. Contrarily, in its chronic form, ossification of the patellar tendon may be rarely seen. Further complementary examination is unnecessary. Radiographs themselves are not always required, especially when the clinical findings are typical, and the pain is bilateral [6,7]. Care must be taken in case of clinical doubt and radiographs must be obtained in the search for a differential diagnosis, particularly bony tumors.

Sinding-Larsen-Johansson syndrome is the equivalent of Osgood-Schlatter disease of the proximal insertion of the patellar tendon [3]. Clinically, the child complains of pain on the anterior aspect of the knee; the patient cannot always precisely localize the pain. Palpation of the tip of the patella with the knee in extension and the quadriceps relaxed elicits intense pain. As in Osgood-Schlatter disease, radiographs are most commonly normal. In more chronic presentation, a spur may be seen on the inferior pole of the patella.

At the level of the lower limbs, the type of overuse injury also depends on the type of sporting activity. In runners, in addition to the two previously discussed injuries, one of the most frequent ailments is iliotibial band syndrome [8,9]. Findings are characteristic, since they occur mainly during the act of running. The pain is localized on the lateral side of the knee, precisely on the lateral aspect of the lateral femoral condyle. The pain is so intense that the child will inevitably discontinue the physical activity. The lateral condyle is tender, and rest provides relief. However, return to running unavoidably reawakens the pain. However, participating in other sporting activities that load the knee in a different manner than running may be possible without awakening the pain. Iliotibial band syndrome is generally due to excessive friction between the distal iliotibial band and the lateral femoral epicondyle.

In girls, pain during the act of running is most frequently localized over the anterior tibia [9]. Two entities are to be distinguished: Medial tibial stress syndrome (MTSS), and stress fractures. MTSS is more commonly encountered in girls, those with little experience in running, those with a previous MTSS, and those with a high body mass index (BMI). Contrarily, stress fractures are found in high-level adolescent runners [10-12]. It is important to note that stress fractures occur on a normal bone. Conventional radiographs are therefore essential in the workup of the pain, although they are often insufficient for the official diagnosis. A common finding is thickening of the anterior cortex of the tibia. However, the fracture line may be subtle and difficult to identify. MRI or CT-scans are sometimes necessary in order to

make an official diagnosis [4]. Physicians must be prudent when treating children with overuse injuries since they may be pressured by the child's parents, especially since diagnostic delay often leads to apprehension. In some cases, if a tumor is included within the differential diagnoses, complementary exams must be ordered in order to rule out the diagnosis. MRIs are not always beneficial in stress fractures since cortical bone density is high, and the low spatial resolution of the MRI does not allow identification of the fracture line.

Sever disease is an osteochondrosis similar to Osgood-Schlatter disease and is localized at the level of the insertion of the Achilles tendon on the calcaneus [1-4]. Sever disease is very frequently encountered in children during growth spurts. Patients typically complain of pain at the level of the heel that is exacerbated while walking and particularly during running. For some patients, mere contact between the heel and the floor may be impossible due to excruciating pain, leading these patients to walk on the tips of their toes. On physical exam, there is tenderness while pinching the heel or while palpating the insertion of the Achilles tendon. Radiographs are rarely required except when there is diagnostic doubt. Fragmentation of the secondary ossification center of the calcaneus is a normal finding and is not a sign of Sever disease. Stress fractures may also occur level of the foot. Nevertheless, their prevalence remains too low thereby precluding a discussion in this chapter. In patients presenting with foot pain in the setting of intense physical exercise, a stress fracture must be considered, and an MRI – the preferred imaging modality – must be ordered.

## **Upper limb pain**

Overuse injuries of the upper limbs are usually due to excessive traction or compression at the level of a joint. The 3 most frequently encountered injuries in the literature are:

- Gymnast's wrist
- Little leaguer's shoulder
- Little leaguer's elbow

The last two listed injuries are extremely rare in Europe where baseball is not a commonly practiced sport, although they are common entities in adolescent pitchers in the United States. Moreover, gymnastics is a pediatric sport that is almost exclusively high-performance, even though the Olympic games are reserved for those older than 16 years of age. Gymnasts reach their highest level of performance even before puberty, with 75% of gymnasts having already reported wrist pain during practice or competition [4].

Gymnast's wrist is an injury that arises due to repetitive compressions of the wrist in hyper-extension. As a result, there is premature closure of the distal physis of the radius. Initially, pain is felt at the level of the wrists, and radiographs are most commonly normal, and MRI may show edema of the distal metaphyses of the radius and ulna [13,14].

Little leaguer's elbow is a generic term to describe a group of injuries of the child's elbow that occur in baseball players [4,15]. However, Little leaguer's elbow specifically affects the medial epicondyle of the elbow and is caused by repetitive traction in children aged between 11 to 15 years old thus leading to chronic widening of the physis of the medial epicondyle. Nonetheless, its occurrence in Baseball players is exceptional in France, although it may be

seen in tennis players. The famous “tennis elbow” encountered in adults may be translated in children by a lesion of the ossification center of the medial epicondyle. Radiographs show widening of the physis and the diagnosis is confirmed by signs of inflammation on an MRI.

Little leaguer’s shoulder corresponds to epiphysiolysis of the proximal humerus due to the repetitive motion of pitching [15,16]. This injury is exceptional in France.

#### TREATMENT AND PREVENTION [1,6]

The treatment of overuse injuries is discussed in another chapter. Nevertheless, the essential concepts of treatment and especially the prevention of overuse injuries will be touched upon.

Once the diagnosis is made, it is fundamental to approach these injuries in their entirety, and risk factors should be identified promptly. Intrinsic and extrinsic risk factors should be differentiated [4,17].

Intrinsic risk factors include the child’s internal personal factors. These may be further divided into modifiable and non-modifiable risk factors.

Modifiable intrinsic risk factors include BMI, strength, and flexibility [3,4,8,18]. Non-modifiable intrinsic risk factors include age, height, timing of the pubertal growth spurt, and previous overuse injuries. Moreover, having previously been diagnosed with an overuse injury is the primary risk factor for the occurrence of another.

Extrinsic risk factors are, by definition, modifiable and are related to the child’s exercise regimen: Volume, intensity, type of coaching, variability of the exercises, and the level of competition before the start of the present season [4,8,9,17].

There is no consensus on prevention strategies. However, a period of active rest after a competition cycle is indicated. Adapted training with more variability is also recommended [17].

There is no consensus of the optimal treatment approach either. Some studies suggest complete cessation of sporting activities, while others suggest adapting the physical activity based on the child’s symptoms in order to limit the psychological impact of cessation of sports in these young athletes. Some authors suggest programs with stretching and physical conditioning [19]. However, no studies have compared the different therapeutic approaches. It is always recommended, independently of the adopted therapeutic strategy, not to return to intensive competition or sports until after the pain has completely subsided [4].

The relationship between the sports medicine physician, surgeon, sports instructor, parents, and child must be fluid and transparent in order to, firstly reassure the patient and their family, and secondly to accompany the often-protracted healing process. This may sometimes even lead to a reconsideration of the practiced sports. However, numerous prejudices often persist, and it may sometimes be difficult to discuss these sensitive topics with the patients and their families. Nevertheless, it is paramount to remain centered on the initial objective and to remain focused on the child’s well-being rather than their performance.

## REFERENCES

1. Launay F. Sports-related overuse injuries in children. *Orthop Traumatol Surg Res.* 2015;101(1 Suppl):S139-47. Epub 2014/12/30. doi: 10.1016/j.otsr.2014.06.030. PubMed PMID: 25555804.
2. Stracciolini A, Casciano R, Friedman HL, Meehan WP, Micheli LJ. A closer look at overuse injuries in the pediatric athlete. *Clin J Sport Med.* 2015;25(1):30-5. doi: 10.1097/JSM.000000000000105. PubMed PMID: 24926911.
3. Wu M, Fallon R, Heyworth BE. Overuse Injuries in the Pediatric Population. *Sports Med Arthrosc Rev.* 2016;24(4):150-8. doi: 10.1097/JSA.000000000000129. PubMed PMID: 27811514.
4. Arnold A, Thigpen CA, Beattie PF, Kissenberth MJ, Shanley E. Overuse Physeal Injuries in Youth Athletes. *Sports Health.* 2017;9(2):139-47. Epub 2017/02/06. doi: 10.1177/1941738117690847. PubMed PMID: 28165873; PubMed Central PMCID: PMC5349397.
5. Leppänen M, Pasanen K, Clarsen B, Kannus P, Bahr R, Parkkari J, et al. Overuse injuries are prevalent in children's competitive football: a prospective study using the OSTRC Overuse Injury Questionnaire. *Br J Sports Med.* 2019;53(3):165-71. Epub 2018/08/14. doi: 10.1136/bjsports-2018-099218. PubMed PMID: 30108062.
6. Journeau P, Polirzstok E, Launay F, Barbier D. [OVERUSE INJURIES IN THE YOUNG ATHLETE]. *Rev Prat.* 2015;65(8):1084-90. PubMed PMID: 26749713.
7. Chang GH, Paz DA, Dwek JR, Chung CB. Lower extremity overuse injuries in pediatric athletes: clinical presentation, imaging findings, and treatment. *Clin Imaging.* 2013;37(5):836-46. Epub 2013/06/04. doi: 10.1016/j.clinimag.2013.04.002. PubMed PMID: 23759208.
8. Hogan KA, Gross RH. Overuse injuries in pediatric athletes. *Orthop Clin North Am.* 2003;34(3):405-15. doi: 10.1016/s0030-5898(03)00006-3. PubMed PMID: 12974490.
9. Seto CK, Statuta SM, Solari IL. Pediatric running injuries. *Clin Sports Med.* 2010;29(3):499-511. doi: 10.1016/j.csm.2010.03.005. PubMed PMID: 20610035.
10. Shelat NH, El-Khoury GY. Pediatric stress fractures: a pictorial essay. *Iowa Orthop J.* 2016;36:138-46. PubMed PMID: 27528851; PubMed Central PMCID: PMC5349397.
11. Changstrom BG, Brou L, Khodae M, Braund C, Comstock RD. Epidemiology of stress fracture injuries among US high school athletes, 2005-2006 through 2012-2013. *Am J Sports Med.* 2015;43(1):26-33. Epub 2014/12/05. doi: 10.1177/0363546514562739. PubMed PMID: 25480834.
12. Heyworth BE, Green DW. Lower extremity stress fractures in pediatric and adolescent athletes. *Curr Opin Pediatr.* 2008;20(1):58-61. doi: 10.1097/MOP.0b013e3282f370c0. PubMed PMID: 18197040.
13. Bell DR, Post EG, Biese K, Bay C, Valovich McLeod T. Sport Specialization and Risk of Overuse Injuries: A Systematic Review With Meta-analysis. *Pediatrics.* 2018;142(3). Epub 2018/08/22. doi: 10.1542/peds.2018-0657. PubMed PMID: 30135085.
14. Lomasney LM, Lim-Dunham JE, Cappello T, Annes J. Imaging of the pediatric athlete: use and overuse. *Radiol Clin North Am.* 2013;51(2):215-26. Epub 2012/12/25. doi: 10.1016/j.rcl.2012.09.014. PubMed PMID: 23472587.
15. Mautner BK, Blazuk J. Overuse throwing injuries in skeletally immature athletes--diagnosis, treatment, and prevention. *Curr Sports Med Rep.* 2015;14(3):209-14. doi: 10.1249/JSR.000000000000155. PubMed PMID: 25968854.

16. Heyworth BE, Kramer DE, Martin DJ, Micheli LJ, Kocher MS, Bae DS. Trends in the Presentation, Management, and Outcomes of Little League Shoulder. *Am J Sports Med.* 2016;44(6):1431-8. Epub 2016/03/16. doi: 10.1177/0363546516632744. PubMed PMID: 26983458.
17. Paterno MV, Taylor-Haas JA, Myer GD, Hewett TE. Prevention of overuse sports injuries in the young athlete. *Orthop Clin North Am.* 2013;44(4):553-64. Epub 2013/08/29. doi: 10.1016/j.ocl.2013.06.009. PubMed PMID: 24095071; PubMed Central PMCID: PMC3796354.
18. Brown T, Moran M. Pediatric Sports-Related Injuries. *Clin Pediatr (Phila).* 2019;58(2):199-212. Epub 2018/11/27. doi: 10.1177/0009922818810879. PubMed PMID: 30477308.
19. Pengel KB. Common overuse injuries in the young athlete. *Pediatr Ann.* 2014;43(12):e297-308. doi: 10.3928/00904481-20141124-09. PubMed PMID: 25486038.