3.1 Injuries associated with pediatric sports practice

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Sports injuries are injuries that occur when engaging in physical activity for competitive or recreational purposes. Their incidence depends on intrinsic and extrinsic risk factors.

> Intrinsic factors may be determined by the individual's genetics or by congenital or constitutional factors, lack of flexibility, balance, and/or coordination, previous injuries, muscle weakness or imbalance, or by physiological and biomechanical characteristics of the growth and development process. Extrinsic risk factors are related to sport-specific requirements, environmental conditions, changes such as: training planning, coach, playing surface or footwear, etc. (Monaco et al., 2018, p.296).

The epidemiological profile of the injuries is related to the specific sport being practiced (Brotons Cuixart, Monaco, Sevilla Moya, Guerra Balic, and Calvo Terrades, 2013). Their incidence increases with age and competitive demand, reaching a peak between ages 10 and 14, both in men and women (Fridman, Fraser-Thomas, McFaull, and Macpherson, 2013; Gottschalk, and Andrish, 2011; Koutures, and Gregory, 2010; Lykissas, Eismann, and Parikh, 2013; Mónaco, 2015; Smith, Chounthirath, and Xiang, 2016). Regarding their distribution by gender, however, some authors report a higher incidence in men, and others, in women (Fridman et al., 2013, Gottschalk, and Andrish, 2011, Lykissas et al., 2013). Many of these studies are based on emergency services, not on population studies. Therefore, greater participation by males, or the sport selected may affect the results, as may higher levels of

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aggression in males in certain disciplines (Caine, Caine, and Maffulli, 2006; Lykissas et al., 2013; Fridman et al., 2013; Magrini, Dahab, and Heyworth, 2016). However, injuries of the anterior cruciate ligament (ACL) are clearly more prevalent in female athletes, probably due to hormonal and biomechanical factors (Wedderkopp, Kaltoft, Holm, and Froberg, 2013).

The main difference in the pediatric population in comparison to adults is the growth and development process. In bones, this is determined by the physeal growth plates and by the secondary ossification centers (apophysis) (Rosendahl and Strouse, 2016). This condition warrants a more conservative and protective attitude when treating young athletes. The use of treatment and return-to-competition protocols for adults in children is inadvisable (Magrini et al., 2016).

Sports Injuries Can Be Acute or Due to Overuse

Acute injuries are more frequent during competition and in lower extremities (i.e., ankle and knee) (Lykissas et al., 2013). This prevalence is influenced by the fact that the lower extremities are predominantly used in most of the sports in our environment. Acute injuries include different clinical conditions, such as sprains, muscle injuries, fractures, injuries of the anterior cruciate ligament (ACL) and concussions.

Joint sprains – most frequently in the ankle – are the main cause of acute injuries (Lykissas et al., 2013; Monaco, 2015). The diagnosis is clinical and treatment consists of relative immobilization and, sometimes, oral anti-inflammatories. However, in the case of joint torsion or suspected ligament injury in pediatric patients, a possible physeal fracture should be considered, since the Ottawa rules (see below) may be less sensitive in young children (Doherty C et al., 2014) (Brotons Cuixart et al., 2013).

Muscle injuries are the second cause of injuries. Muscle and tendon injuries are more frequent during late adolescence (Monaco et al., 2014). The main symptom is abrupt and focal pain at the patient's fingertip, and functional impairment during contraction of the affected muscle.

> Hematoma occurs in cases of total or partial rupture (grade 2-3) and crepitus in cases of chronic tendinopathy. Pain depends on the severity of the injury. In mild cases, it may be absent at rest and appear when stretching. Evening pain in the metaphyseal area is often "considered" growth-related and there is no apparent etiology, but it should not be confused with nocturnal pain that wakes the child from sleep. In this case an oncological cause should always be considered,

> although it may be associated with chronic tendinopathy in post-pubertal patients. Anatomical-functional knowledge will guide us through the etiological and structural diagnosis. (Mónaco et al., 2018, p. 297).

Acute fractures are the fourth cause of injuries (between 18 and 25%) and prevail in upper extremities (in children under the age of 16). They are usually caused by falls or avulsion. Treatment depends on severity and the subject's skeletal maturation (De Inocencio, 2004, De Inocencio, Carro, Flores, Carpio, Mesa, and Marín, 2016, Randsborg et al., 2013, Smith et al., 2016). "Physeal fractures, typical of the bone in formation, require special attention because they can influence the growth of the affected limb" (Monaco et al., 2018, p.297). They depend on skeletal immaturity and are usually sport-specific (Rosendahl, and Strouse, 2016).

In older adults, ACL injury can occur in the knee when there is trauma in flexion and forced valgus. There is a higher incidence in women with joint hypermobility, in the presence of gene valgum and in certain sports, such as soccer, handball or skiing. However, the same situation in prepubertal or skeletally immature patients can favor a fracture of the tibial spine (lateral intercondylar) instead of an ACL injury. This is due to incomplete ossification of the tibial spine during growth and to a relative bone weakness with respect to the ligaments. These acute injuries are among the most severe that should be considered. The difference between these clinical conditions is determined by the skeletal maturity (McConkey, Bonasia, and Amendola, 2011, Randsborg et al., 2013, Stracciolini, Casciano, Friedman, Meehan, and Micheli, 2015). Its exploration may be similar to ACL (pain, immediate inflammation, positive or equivocal Lachman's test) and require imaging studies to confirm the diagnosis.

Cranial trauma is another severe injury. In recent years, pediatric specialists have become more interested in this type of injury due to its increased incidence.

> They are more frequent in men and in contact sports (soccer, rugby, handball, boxing, martial arts). Some experts call it concussion, which is a type of minor cranial trauma (Minor Traumatic Brain Injury- TBIm). It causes a series of metabolic changes on the neuronal level. (Mónaco et. al., 2018, p. 297). These changes occur due to a transient interruption of cerebral blood flow, which causes a complex pathophysiological process in the brain (Maugans, Farley, Altaye, Leach, and Cecil, 2012).

> These changes manifest themselves as an alteration of brain function, affecting memory, orientation and/or cognitive function to varying degrees. It may occur due to a direct contusion (head, face or neck) or to deceleration or rotational forces that are transferred to the brain. Loss of consciousness only occurs in 8-19% of all cases and diagnosis requires no imaging studies. Symptoms can be physical, cognitive, emotional or sleep disorders. (Mónaco et al., 2018, p. 297).

Many of these symptoms are subtle and this is a cause for underdiagnosis within this population. For this reason, the medical community is increasingly interested in this entity. The condition usually resolves spontaneously in 7 to 14 days, although in children it requires a longer recovery time, and some symptoms may even persist for months or years. These cases should be monitored by SCAT5, an evaluation and monitoring method specifically developed for this pathology. (Davis, G.A. et al, 2017) (Mónaco et al., 2018, p. 297).

This is considered a monitoring method, not a diagnostic method. Treatment consists of resting until the symptoms disappear. Return to competition requires the specialist's criteria, with a gradual progression of training. Simultaneous psychological treatment is sometimes indicated (Ledoux et al., 2017). The first intervention is carried out on the playing field and – in the case of the slightest suspicion – the player must be removed from the field and all physical activity suspended for a minimum of 24 hours, until the symptoms are resolved or a specialist has made an assessment. This is recommended in order to avoid the second impact syndrome, which is caused by the transient interruption of cerebral blood flow and its possible consequences. A Pocket Concussion Recognition Tool is used for this, preferably in the player's native language (Maugans et al., 2012; Rose, Weber, Collen, and Heyer, 2015; Nelson, Loman, LaRoche, Furger, and McCrea, 2017; McCrory et al., 2017). This topic will be developed in another lecture.

Figure 1: Pocket Concussion Recognition Tool

Pocket CONCUSSION RECOGNITION TOOL™

To help identify concussion in children, youth and adults

RECOGNIZE & REMOVE

Concussion should be suspected if one or more of the following visible clues, signs, symptoms or errors in memory questions are present.

1. Visible clues of suspected concussion

Any one or more of the following visual clues can indicate a possible concussion:

Loss of consciousness or responsiveness
Lying motionless on ground / Slow to get up
Unsteady on feet / Balance problems or falling over / Incoordination
Grabbing / Clutching of head
Dazed, blank or vacant look
Confused / Not aware of plays or events

2. Signs and symptoms of suspected concussion

Presence of any one or more of the following signs & symptoms may suggest a concussion:

- Loss of consciousness
- Seizure or convulsion
- Balance problems
- Nausea or vomiting
- Drowsiness
- More emotional
- Irritability
- Sadness
- Fatigue or low energy
- Nervous or anxious
- "Don't feel right"
- Difficulty remembering
- Headache
- Dizziness
- Confusion
- Feeling slowed down
- "Pressure in head"
- Blurred vision
- Sensitivity to light
- Amnesia
- Feeling like "in a fog"
- Neck pain
- Sensitivity to noise
- Difficulty concentrating

3. Memory function

Failure to answer any of these questions correctly may suggest a concussion.

"What venue are we at today?"
"Which half is it now?"
"Who scored last in this game?"
"What team did you play last week / game?"
"Did your team win the last game?"

Any athlete with a suspected concussion should be IMMEDIATELY REMOVED FROM PLAY, and should not be returned to activity until they are assessed medically. Athletes with a suspected concussion should not be left alone and should not drive a motor vehicle.

It is recommended that, in all cases of suspected concussion, the player is referred to a medical professional for diagnosis and guidance as well as return to play decisions, even if the symptoms resolve.

RED FLAGS

If ANY of the following are reported then the player should be safely and immediately removed from the field. If no qualified medical professional is available, consider transporting by ambulance for urgent medical assessment:

- Athlete complains of neck pain
- Increasing confusion or irritability
- Repeated vomiting
- Seizure or convulsion
- Weakness or tingling / burning in arms or legs
- Deteriorating conscious state
- Severe or increasing headache
- Unusual behaviour change
- Double vision

Remember:

- In all cases, the basic principles of first aid (danger, response, airway, breathing, circulation) should be followed.
- Do not attempt to move the player (other than required for airway support) unless trained to so do.
- Do not remove helmet (if present) unless trained to do so.

from McCrory et. al, Consensus Statement on Concussion in Sport. Br J Sports Med 47 (5), 2013

Source: Adapted from http://bit.ly/2oKP4JT

On the other hand, the relationship between excess in training volume and intensity is one of the main causes of overuse injuries, which at this age are more frequent than acute injuries because of the determining role of growth (Magrini et al., 2016). These injuries are the most prevalent in children at pediatric age (over 50%) since they mainly affect immature athletes (either physically or emotionally). This prevalence is due to a combination of factors, particularly during early specialization (Carter, and Micheli, 2011, Franklin, Weiss, 2012, Gregory, Kerr, and Parsons, 2016, Magrini et al., 2016, Mostafavifar, Best, and Myer, 2013; Myer, Lloyd, Brent, and Faigenbaum, 2013).

The most common injuries are osteochondrosis (and within these apophysitis); also lumbagos, patellofemoral syndrome,

iliotibial band syndrome, periostitis/stress fractures and overtraining or “burnout” syndrome, among others.

Peak height velocity (PHV) occurs concomitantly with “relative bone weakness” and greater absolute muscle strength. These factors, associated with a specific and repetitive athletic motor pattern facilitate the appearance of injuries. This is why many pathologies are sport-specific, such as Sever’s disease and Osgood-Schlatter's disease in soccer and track and field, Little League Elbow in baseball, Distal Radial Physeal Stress Syndrome or spondylolysis/listhesis in gymnasts, as well as the pelvic osteochondrosis in soccer.

Apophysitis is a type of osteochondrosis in an immature skeleton’s bone-tendon junction. It is the equivalent of enthesitis (insertional tendinopathy) in adults. Initial symptomatology is insidious pain or discomfort that worsens with physical activity and decreases with rest (except in the case of avulsion, which is a “tearing,” with symptoms beginning suddenly). Severe cases can manifest constant pain that affects all regular daily activities. Diagnosis is clinical and imaging studies such as simple X-rays or nuclear magnetic resonance are only used for the differential diagnosis if other pathologies are suspected or to confirm an avulsion. They are also indicated if the condition worsens or fails to improve after one week of treatment. Musculoskeletal ultrasound is much more sensitive and therefore better suited for these pathologies, although it is rarely used in primary care due to its limited availability and the proper prognosis of these disorders. (Mónaco et al., 2018, pp. 297-298).

Prevention consists of flexibility work before PHV, and stabilization work of the agonist-antagonist muscles, together with training load adaptation and periodization.

Lumbagos are frequent in the pediatric age (20-30%), although they don’t always merit consultation. They’re more prevalent during PHV or associated with short hamstring syndrome. Typical adolescent transient osteo-muscular imbalance induces this pathology. As a general rule, all lumbar pain during anterior trunk flexion indicates a mechanical etiology or involvement of the anterior vertebral

> region (e.g., herniated disc) and pain during lumbar hyperextension is a sign of a facet syndrome. Various conditions may be the etiological cause of the latter, but spondylolysis (isthmic fracture) should always be ruled out in young people. The diagnosis can be confirmed by lumbar X-rays (lateral and bilateral oblique PA). (Mónaco et al., 2018, p. 298).

The indicated treatment is rest or a Boston brace (MacDonald, Stuart, and Rodenberg, 2017; Patel, and Kinsella, 2017).

> Patellofemoral syndrome (PFS) is the most frequent cause of gonalgia in adolescents. Its etiology is uncertain, but it is characterized by an imbalance between agonist and antagonist muscles, and a stabilizing insufficiency of the structures adjacent to the patella. This causes a misalignment of the patellofemoral-tibial axis, and results in excessive friction during maximum flexion-extension movement in areas that are not usually involved. (Mónaco et al., 2018, p. 298).

Retro or peripatellar pain is typical and the articular cartilage is sometimes involved (Halabchi, Mazaheri, and Seif-Barghi, 2013; Kim, et al., 2016).

> This misalignment is associated with an increase in the Q angle, which is caused by an increase the bitrochanteric diameter and is therefore more frequent in women. It is characterized by a sensation of joint instability ("knee failure") after prolonged sitting, pain when going up or down stairs, and sometimes inflammation. The patellar joint facet is painful on palpation (or when it is moved) and Zohlen's sign is positive, but not pathognomonic. Knee X-rays require specific projections and guide the diagnosis. Treatment consists of physiotherapy and complete physical inactivity is contraindicated.
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> Iliotibial band syndrome is less frequent than the pathologies described above (prevalent in cyclists and runners). It is characterized by pain and increased tension on the side of the thigh (positive Ober's test). When this condition is associated with weakness of the gluteus medius,

biomechanics of the gait can be altered (positive Trendelemburg gait). Palpation of the external femoral condyle on the flexion-extension mechanism of the knee (30-90 degrees) assists in diagnosis, and the treatment is physiotherapeutic.

Periostitis is the inflammation of the periosteum caused by multiple factors, which include biomechanical aspects (e.g., tibia vara or pronation of the foot), sudden changes in training intensity and/or duration, footwear or playing surface. Although it is most frequently located in the tibia, it may be located elsewhere, and it is sport-specific (common in long-distance runners). The clinical symptom is diffuse, insidious pain in 2/3 of the posteromedial tibia. It improves with rest and worsens with physical activity. Bone pain and roughness may be detected on palpation. Instances of periostitis can evolve into a stress fracture, in which case sharp and focal pain will be felt on palpation. The diagnosis is clinical and radiological. A plain X-ray will show a thickening of the periosteum (periostitis) and in the case of a stress fracture there will be a solution of continuity at the cortical bone level. In some cases, a bone gammagraphy or a nuclear magnetic resonance (NMR) is required for confirmation of the diagnosis. However, the NMR is more appropriate for earlier stages, and provides information on the different grades of stress or bone edema prior to the fracture (Monaco, et al., 2018, pp. 298-299).

Treatment consists of rest and biomechanical correction or orthosis (Cody O'Dell et al., 2016, De Inocencio et al., 2016, Monaco et al., 2018).

Overtraining or “burnout” syndrome occurs in 30% of adolescent athletes. It is a response to chronic stress during which participation or performance diminishes in an activity that used to be enjoyable. It usually manifests itself with a loss of physical performance over 2 months, with (severe) organic symptoms, poor physiological adaptation to training, and a stress response that cannot be accounted for by organic factors. It also manifests itself with psychological or social symptoms, which are nonspecific and are diagnosed on the basis of a detailed medical record in order to rule out organic causes (Table 3). Treatment consists of relative rest and modification of precipitating factors. Recovery time depends

on the disappearance of the symptoms, which in some cases may last weeks or months. (Mónaco et al., 2018, p. 299).

References

Brotons Cuixart, D., Mónaco, M., Sevilla Moya, J. C., Guerra Balic, M., and Calvo Terrades, M.(2013) Actividad–física, ejercicio y deporte en la edad pediátrica. En J. Bras i Marquillas and E. De la Flor i Bru (Eds.), Pediatría en Atención Primaria (pp. 169-185). Barcelona, SP: Elsevier Masson.

Caine, D., Caine, C., and Maffulli. N. (2006). Incidence and Distribution of Pediatric Sport-related Injuries. Clinical Journal of Sport Medicine, 16(6), 500-513.

Caine, D., Maffulli, N., and Caine, C. (2008). Epidemiology of Injury in Child and Adolescent Sports: Injury Rates, Risk Factors, and Prevention. Clinical Journal of Sport Medicine, 27(1), 19-50.

Carter, C. W., and Micheli, L.J. (2011) Training the Child Athlete for Prevention, Health Promotion, and Performance: How Much Is Enough, How Much Is Too Much? Clinics in Sports Medicine, 30(4), 679-690. Taken from http://dx.doi.org/10.1016/j.csm.2011.06.004

Cody O 'dell, M., Jaramillo, D., Bancroft, L., Varich, L., Logsdon, G., and Servaes, S. (2016). Imaging of Sports-related Injuries of the Lower Extremity in Pediatric Patients. RadioGraphics, 36(1), 1807-1827.

Davis GA, et al. (2017) Sport concussion assessment tool - 5th Edition. Br J Sports Med 51:851-58 doi:10.1136/bjsports-2017-097506SCAT5

De Inocencio, J. (2004). Epidemiology of Musculoskeletal Pin Primary Care. Archives of Disease in Childhood, 89(5), 431-434.

De Inocencio, J., Carro, M. Á., Flores, M., Carpio, C., Mesa, S., and Marín, M. (2016). Epidemiology of Musculoskeletal Pain in a Pediatric Emergency Department. Rheumatology International, 36(1), 83-89.

Doherty C, Delahunt E, Caulfield B, Hertel J, Ryan J, Bleakley Ch. (2014).The incidence and Prevalence of Ankle Sprain Injury: A systematic review and meta-analysis of prospective epidemiological studies. Sports Med , 44:123-40

Franklin, C.C., and Weiss, J.M. (2012). Stopping Sports Injuries in Kids. Current Opinion in Pediatrics, 24(1), 64-67. Taken from http://content.wkhealth.com/linkback/openurl?sid=WKPTLP:landingpage&an=00008480-201202000-00011

Fridman, L., Fraser-Thomas, J. L., McFaull, S. R., and Macpherson, A. K. (2013). Epidemiology of Sports-related Injuries in Children and Youth Presenting to Canadian Emergency Departments from 2007–2010. BMC Sports Science, Medicine and Rehabilitation, 5(1), 5-30.

Gottschalk, A. W., and Andrish, J. T. (2011). Epidemiology of Sports Injury in Pediatric Athletes. Sports Medicine and Arthroscopy Review, 19(1), 2-6.

Gregory, A., Kerr, Z., and Parsons, J. (2016). Selected Issues in Injury and Illness Prevention and the Team Physician: A Consensus Statement. Current Opinion in Pediatrics, 15(1), 48-59.

Halabchi, F., Mazaheri, R., and Seif-Barghi, T. (2013). Patellofemoral Pain Syndrome and Modifiable Intrinsic Risk Factors; How to Assess and Address? Asian Journal of Sports Medicine, 4(2), 85-100.

Kim, H. K., Shiraj, S., Kang, C. H., Anton, C., Kim, D. H., and Horn, P. S. (2016). Patellofemoral Instability in Children: Correlation between Risk Factors, Injury Patterns, and Severity of Cartilage Damage. AJR. American Journal of Roentgenology, 206(6), 1321-1328.

Koutures, C. G., and Gregory, A. J. M. (2010). Injuries in Youth Soccer. Pediatrics, 125(2), 410-404.

Ledoux A. A., Barrowman, N. J., Boutis, K., Davis, A., Reid, S., Sangha, G., Farion, K. J., Belanger, K., Tremblay, M. S., Owen Yates, K., DeMatteo, C., Reed, N., and Zemek, R. (2017). Multicentre, Randomised Clinical Trial of Paediatric Concussion Assessment of Rest and Exertion (Pedcare): A Study to Determine when to Resume Physical Activities Following Concussion in Children. British Journal of Sports Medicine, (1).

Lykissas, M. G., Eismann, E. A., and Parikh, S. N. (2013). Trends in Pediatric Sports-related and Recreation-related Injuries in the United States in the Last Decade. Journal of Pediatric Orthopaedics, 33(8), 803-10.

Magrini, D., Dahab, K., and Heyworth, B. (2016). Overuse Injuries in the Pediatric Population. Current Sports Medicine Reports, 15(6), 150-158.

MacDonald, J., Stuart, E., and Rodenberg, R. (2017). Musculoskeletal Low Back Pain in School-aged Children. JAMA Pediatrics, 171(3), 280-287.

Maugans, T. A, Farley, C., Altaye, M., Leach, J., and Cecil, K. M. (2012). Pediatric Sports-Related Concussion Produces Cerebral Blood Flow Alterations. Pediatrics, 129(1), 28-37.

McCrory, P., Meeuwisse, W., Dvorak, J., Aubry, M., Bailes, J., Broglio, S., Cantu, R.C., Cassidy, D., Echemendia R. J., Castellani, R. J., Davis, G. A., Ellenbogen, R., Emery, C., Engebretsen, L., Feddermann-Demont, N., Giza CC20,21, Guskiewicz KM22, Herring S23, Iverson GL24, Johnston KM25, Kissick, J., Kutcher, J., Leddy, J. J., Maddocks, D., Makdissi, M., Manley G. T., McCrea, M., Meehan, W. P., Nagahiro, S., Patricios, J., Putukian, M., Schneider, K. J., Sills, A., Tator, C. H., Turner, M., and Vos, P. E. (2017). Consensus Statement on Concussion in Sport—the 5th International Conference on Concussion in Sport Held in Berlin, October 2016. British Journal of Sports Medicine,

Mónaco, M. (2015). Epidemiología de las lesiones del balonmano en período formativo y profesional [Doctoral thesis]. Universidad Autónoma, Barcelona, Spain. Taken from http://bit.ly/2D12aa2

Mónaco, M., Gutiérrez Rincón, J. A., Montoro Ronsano, J. B., Til, L., Drobnic, F., Nardi Vilardaga, J., Puigdellivol Grifell, J., Pedret Carballido, C., and Rodas, G. (2014). Epidemiología lesional del balonmano de elite: Estudio retrospectivo en equipos profesional y formativo de un mismo club. Apunt Med l'Esport, 48(181), 11-19.

Mónaco, M., Gutiérrez Rincón, J. A, Montoro Ronsano, J. B., Drobnic, F., Til Pérez, L., Ibáñez Toda, L., Pedret Carballido, C., Nardi Vilardaga, J., and Rodas, G. (2015). Estudio prospectivo de maduración, desarrollo e incidencia lesional en balonmano formativo de élite. ¿Puede el estado madurativo ser un factor determinante de la incidencia lesional en balonmano? Apunts Medicina de l'Esport, 50(185), 5-14.

Mónaco, M. Pérez Martínez, E., Sevilla Moya, J. C., Gutiérrez Rincón, J. A., Brotons Cuixart, D., Schack, M., and Calvo Terrades, M. (2018). Consejos y patología asociada a la práctica deportiva. En AEPad (Ed.), Curso de Actualización Pediatría 2018 (pp. 293-307). Madrid, ES: Lúa.

Mostafavifar, A. M., Best, T. M., and Myer, G. D. (2013). Early sport specialisation, does it lead to long-term problems? British Journal of Sports Medicine, 47(17), 1060-1061.

Myer, G. D., Lloyd, R. S., Brent, J. L., and Faigenbaum, A. D. (2013). How young is too young to start training? ACSM's Health & Fitness Journal, 17(5), 14-23.

Nelson, L. D., Loman, M. M., LaRoche, A. A., Furger, R. E., and McCrea, M. A. (2017). Baseline Performance and Psychometric Properties of the Child Sport Concussion Assessment Tool 3 (Child-SCAT3) in 5- to 13-year-old Athletes. Clinical Journal of Sport Medicine, 27(4), 381-387.

Patel D. R. and Kinsella, E. (2017). Evaluation and Management of Lower Back Pain in Young Athletes. Translational Pediatrics, 6(3), 225-235. Taken from http://tp.amegroups.com/article/view/15692/15759

Randsborg, P. H., Gulbrandsen, P., Benth, J. Š., Sivertsen, E. A., Hammer, O. L., Fuglesang, H. F. S., and Arøen, A. (2013). Fractures in Children: Epidemiology and Activity-Specific Fracture Rates. The Journal of Bone and Joint Surgery, 95(7), 533-545.

Rose, S. C., Weber, K. D., Collen, J. B., and Heyer, G. L. (2015). The Diagnosis and Management of Concussion in Children and Adolescents. Pediatric Neurology, 53(2), 108-118. Taken from http://dx.doi.org/10.1016/j.pediatrneurol.2015.04.003

Rosendahl, K. and Strouse, P. J. (2016). Sports Injury of the Pediatric Musculoskeletal System. La Radiologia Medica, 121(5), 431-41.

Smith, N. A, Chounthirath, T., and Xiang, H. (2016). Soccer-Related Injuries Treated in Emergency Departments: 1990-2014. Pediatrics, 138(4),. Taken from http://bit.ly/2tlIbDI

Stracciolini, A., Casciano, R., Friedman, H. L., Meehan, W. P., and Micheli, L. J. (2015). A Closer Look at Overuse Injuries in the Pediatric Athlete. Clinical Journal of Sport Medicine, 25(1), 30-35.

Wedderkopp, N., Kaltoft, M., Holm, R., and Froberg, K. (2003). Comparison of Two Intervention Programmes in Young Female Players in European Handball - with and without Ankle Disc. Scandinavian Journal of Medicine & Science in Sports, 13, 371-375.