



**CAPE FEAR
SPORTS MEDICINE**

PREADOLESCENT SPORTS MEDICINE

The preadolescent athletes are typically those athletes who have just achieved or have not yet achieved Tanner stage II. Age in girls is usually less than age 12 and age in boys is usually less than age 14. There has been a significant trend in sports medicine to see elite athletes at a younger age participating and training at a very high level, for instance the most recent Wimbledon's champion, Maria Sharapova, is 17 years of age. The most popular female draw in women's golf is Michelle Wie, age 14, and Freddy Adu at age 14 is the highest paid professional soccer player. There is a significant trend in age towards sports participation, especially those sports which require significant flexibility such as gymnastics, where a relatively young age seems to dominate the sport and the majority of the athletes at the elite level have been training intensely for several years, beginning in the very early childhood, frequently as early as three to four years of age, obtaining an elite level by age eight to nine and then developing those skills throughout their teenage years. In addition, there is a strong emphasis on developing our athletes much in the way that professional athletes who are viewed through the media are seen. This creates somewhat of a conflict with regard to training regimes, as young athletes are trained and treated as little adults. There is relatively little scientific information with regard to preadolescent physiology and the elite athlete in this level and age group; therefore, a large amount of information that trickles down to parents and coaches is primarily anecdotal and not scientifically based.

Significant time and money is spent developing these young athletes. It is not unusual for a Classic soccer player who is 11 years of age and would be traveling on a regional basis to incur costs anywhere from \$2000-3000/year just to participate, no including parent travel expenses, hotel lodging, and equipment; therefore, costs inclusive of parents can run close to \$5,000/year for high level Classic soccer participation. Certainly this places increased stress on the young athlete as well as the parents and family.

Sports specialization seems to be a common practice even prior to the age of 12. It is recommended that specialization not begin before age 10, but certainly these recommendations are probably over-constricting as the benefits of multi-sport participation provides for enhanced athletic skills. It prevents athlete burn-out as well as delays in specialization allow for athletes to participate in several sports, as their physical development may lead them to not be competitive early on, but as they become somewhat older would become much more competitive in those sports where the physical size of the athlete is significant. It is difficult for very young athletes to develop a high level of skill participation with certain highly skillful activities, including skipping, jumping and landing, and they do not have the ability for significant powerful movements that are required in certain sports participations; therefore, early specialization can narrow the field of participants who could do very well in sports that require those demands and this may become an exclusionary aspect for the athletes, as they may not have the opportunity to develop the necessary skills when they become older to subsequently participate. The area of communication is very important to both coaches, parents, and administrators who tend to keyhole certain athletes into an individual sport early on and place a high level of demand and term this "commitment." Certainly the three-sport athlete is a dying breed.

The American College of Sports Medicine reviewed injury patterns and noted that there was significantly less free play and much more organized sports participation, although in general there is a relative lack of fitness in the United States and this is suspicious for lack of free play. There certainly is a problem with preadolescent obesity, lack of relative fitness, and decreased exercise levels throughout this age group. Probably over 60% of

Dale W. Boyd, Jr., MD | Debbie Sherman, PA-C

6019 Oleander Drive | Suite 200 | Wilmington | North Carolina | 28403 | t 910-790-9714 | f 910-791-1063

preadolescents do not meet fitness standard guidelines and do not exercise on a regular basis. Certainly this is of significance because it carries over to adulthood and leads to associated conditions with obesity, i.e. diabetes, hypertension, and coronary artery disease. There is definitely an increase in organized sports participation, which may provide some relative benefits and allow for fitness levels to be achieved, but certainly may provide for increased injury rates in addition. These numbers have not been absolutely substantiated in the literature. Most literature information comes from emergency room visits and certainly does not provide an overall accurate reflection of injury patterns.

Care of the young athlete is important. As a physician and provider of care for athletes it is important to understand the sports environment. This means time frames during the year of participation, frequency of participation, frequency of practice sessions, equipment involved in participation, timing during the year of true competitive seasons, objectives for participation, opportunities for advancement, and specific injury patterns that occur with regard to specific sports. There are a large number of year round "elite athletes" at this point in time, which have very specific injury patterns.

For instance, a gymnast will tend to participate at a very high level, train at a high level during their young years, peak if they become an early teenager towards high level of competition. They will frequently train 20 hours per week. This creates a significant increased frequency for overuse injuries. Competitive season tends to run both in the pre-collegiate arena in the fall and springtime. They will frequently spend close to 25% of their training time in an injured state and performing rehabilitation measures to allow for recovery of overuse injuries. Certainly affects of training can tend to cause physiologic changes, which are different from other athletes. In gymnasts training at an intense level, each year of intense training probably delays onset of menarche by approximately five months and certainly there is some relative need for concern with regard to eating disorders and those concerns related to maintenance of body weight.

PARENTS

The parents are the chief monetary resources. There are no real sponsors for events and the parents typically shoulder the majority of the financial burden. This places a significant burden on parents, family, other siblings, and even the athlete. The parents serve frequently as coaches at the lower levels. As the children become more elite in their participation, the parents are frequently not involved in the coaching and, therefore, there are some differing dynamics with regard to parents and coaches' relationships. There is significant time and effort away from home and work. It is a large sacrifice for the parents. When injuries occur, the parents want informed, knowledgeable, timely medical care for their "athlete." This is certainly of primary concern as a medical provider. Again it is important to be knowledgeable of their sport participation and to try to be understanding of their situation and spend an appropriate amount of time discussing the sport, time frames of play and practice, and upcoming competitive schedule prior to evaluating for specific injury. It is critical to disseminate educational information to the parents. Evidence-based type medical practice is ideal in this situation and providing literature to help support discussion of injury patterns and decision-making can be very beneficial. The National Youth Sports Safety Foundation established in 1989 was established to assist in the distribution of educational resources. Certainly the majority of information in today's sporting environment occurs through the Internet, coaches, and other para healthcare individuals who

probably are less suited to provide anything other than anecdotal information rather than true literature supported and documented information. Unfortunately, parents seem to seek these sources rather than physician-based information or sources from dedicated individuals who care for athletes on a regular basis, such as certified athletic trainers.

PHYSIOLOGY

Preadolescent athletes are not “little adults.” They have decreased aerobic and anaerobic capacities, although their aerobic capacities can be developed to an extent, anaerobic power--4- type activities are difficult to develop and for those to develop would require significantly long training sessions. This is probably counterproductive in preadolescent athletes. In addition, they have a relative decreased heat tolerance, although they have an increased number of sweat glands, the sweat glands themselves are less efficient. Therefore, with training, hydration is critical and limiting time frames of training, and environmental concerns with regard to time of the year with regard to outdoor participation is of concern.

PREVENTATIVE MEASURES

Overuse injuries seem to predominant most sports-related activities, especially in the preadolescent injuries. Certainly open physal status plays a role with this and is of concern, as repetitive loads to the physes may lead to permanent abnormalities. For instance, it has been noted in young throwing athletes that develop shoulder pain that it may actually lead to early or premature arrest of their physes and have a fixed internal rotation deformity of their shoulder, which leads to loss of internal rotation on a permanent basis, elbow overload, and difficulty with throwing. If this begins early in the preadolescent stage, it typically leads to inability to throw at the higher levels. It is of note that the majority of high-level pitchers have never had elbow or shoulder pain; therefore, it is paramount to limit the number of throws in this environment. There are several publications with regard to the number of innings pitched based on age, but it has been noted that baseball pitching greater than 300 pitches per week, whether in practice or play, will significantly increase the risks of elbow pain.

Preventative measures that may be effective in decreasing the incidence of injuries include some general fitness training. Certainly low levels of anaerobic and aerobic conditioning can be of benefit. Core trunk type exercises that provide trunk stabilization may be beneficial in the early training phases, as well as gradual progression of aerobic and anaerobic type exercising. Again, it is probably not of significant benefit to proceed with significant anaerobic type exercise in these young individuals. Skill-related activities, in general light fitness training, seem to be of significant benefit. It is important to encourage nonspecialization in this age group.

Modification of rules are of benefit. For instance, a smaller field size to lessen the amount of overall running with field type sports, such as football, soccer participation, and lacrosse may be of benefit. Modification in the rules with shorter duration periods with regard to wrestling, sports that involve significant physical contact

matching age size and Tanner stage reduces injury occurrence. Matching up children with larger individuals seems to be more of a problem as the children are older. In the boys older than approximately 10-12 years of age, as there is a significant discrepancy with regard to sizes during those age groups as well as ability to develop powerful movements, which increases the kinetic energy of injury and, therefore, increases injury patterns. It is very unusual in Pop Warner football at the younger levels to see significant injuries and, again, the incidence of injuries related to bicycle accidents, skateboarding, and trampoline with regard to catastrophic type injuries is much higher than those related to preadolescent sports participation.

STRENGTH TRAINING

There is now excellent literature support that demonstrates that strength training can provide neurofacilitation and increased strength without muscular hypertrophy, which is seen in adolescents, as they reach puberty. As recently as the 1970's there was literature that dissuaded individuals from strength training activities in the preadolescent age group, as a significant benefit was not noted and there was felt to be possible injury to physique status. This has been refuted. There is excellent recent literature to support this activity. It provides neurofacilitation and increased strength without muscular hypertrophy. It needs to be carried out following a basic fitness program. Supervision is essential. Relatively low loads. Emphasis on core trunk activities seem to be of relative benefit and may enhance one's ability to participate at a high level with regard to sports in the preadolescent age group. Sports participation programs have been developed. They are best carried out, though, in a supervised situation to prevent injury. This is distinctly different from weight training, which is typically viewed as using free type weights, barbells, dumbbells, and circuit training activities. Certainly a combination of activities, including weight training can be incorporated, but emphasis again needs to be on neurofacilitation through a variety of exercises with relatively light weights and loads, primarily body weighted activities in a well supervised environment.

PERIODIZATION OF TRAINING

A key factor that is missed is time off from participation due to year round participation. It is appropriate to periodize the training, whether it be a specific strength-training program versus the sport itself. Time frames offer critical peaking towards tournaments or higher levels of competition and require realistic goals set by coaches and parents. This needs to be transmitted to the preadolescent athletes. A simple schedule could include three to four weeks of practice and then a week off from any specific sports participation with substitution of other activities or just light recreational activities. In addition, this would provide the significant benefit of lessening risks of preadolescent burnout. It is important to note that we are in the "age of information," but not all information is scientifically substantiated or objective. Frequently, parents, coaches, and administrators do not use medical resources for their information. There is a large number of money to be made on the athletic preadolescent sports industry with regard to equipment, nutritional supplementation, as well as coaching costs. It seems that a large number of information is gained from anecdotal sources and not scientifically backed. There is some relative literature lag, but certainly literature is being developed to substantiate most parental questions at this point in time. (Copy of bibliography attached).

Frequently asked questions include: Do shin guards decrease fractures? Is heading of a ball in soccer dangerous? Is weight training harmful in preadolescents? Are ACL injuries preventable? Is football at the Pop Warner level dangerous? Questions regarding adolescent sports injuries, mechanism of injury, macrotrauma, sudden acute injury, i.e. fractures, sprains, strains, contusions, and microtrauma, repetitive injury such as stress fractures and apophysitis are frequently asked.

SITE SPECIFIC INJURIES

The Knee: The most serious or significant injury to the knee from a traumatic standpoint is a traumatic hemarthrosis. Specific conditions exist when there is a traumatic injury to the knee and a traumatic hemarthrosis occurs. The young athletes will present to the office with difficulty weight bearing, a large amount of swelling in their knee, limited range of motion of their joint on an acute basis with swelling occurring within two to four hours following the injury, sometimes even more rapidly. Conditions associated with a traumatic hemarthrosis include 1) patellar dislocations, 2) osteochondral fractures, 3) peripheral meniscal tears, and 4) anterior cruciate ligament injuries. It was initially felt that the traumatic hemarthrosis in this age group represented in the majority of cases either an ACL tear or a peripheral meniscal tear. It has been somewhat refuted in the literature more recently. There are a large number of osteochondral fractures which occur to the joint surface that are frequently associated with patellar dislocations and can lead to early arthritis in the knee and are of significant concern with regard to disability of the knee in the future and warrant very aggressive treatment with regard to diagnosis, as imaging studies do not truly elicit those conditions consistently; therefore, in the traumatic hemarthrosis state it is not infrequent to recommend arthroscopic evaluation of the knee and certainly orthopedic surgical referral is of paramount importance in these conditions. With regard to all of these conditions associated with traumatic hemarthrosis they can lead to potential early problems with regard to disability of the knee as well as potential for arthritis in the future and, therefore, need relatively urgent orthopedic care. Physeal fractures also may present as a traumatic hemarthrosis of the knee. There may be associated deformity. They tend to occur in a somewhat older age group, as physeal closure begins to occur centrally. Frequently associated with higher energy injuries, they have a significant potential for growth arrest, especially about the distal femur. Findings may be subtle. Appropriate orthopedic evaluation is of significant benefit. Stress radiographs may identify injuries. It is important to maintain a relative non-weight bearing status and be aware of the potential for growth arrest in the future. Close observation is required in these instances for displaced fractures. Restoration of anatomic alignment with closing the physis is of paramount importance.

OVERUSE INJURIES

Overuse type injuries or microtrauma frequently occur as an apophysitis and they commonly occur during growth sports. They seem to be activity related and not associated with nighttime pain, which helps to differentiate that from other conditions such as infections or tumors. Symptomatic treatment is typically warranted. Addressing inflexibilities seems to be of significant benefit in specific conditions, which include tibial tuberosity apophysitis as well as calcaneal apophysitis. Tibial tuberosity apophysitis has been previously called Osgood-Schlatter's disease. Previous prolonged immobilization does not appear to provide significant

benefit and symptomatic treatment is relatively warranted. Ice, flexibility retraining, and use of Cho-Pat straps may be of some relative benefit and modification in exercise activity levels. Jumping and landing activities seem to be more associated with the tibial tuberosity apophysitis. Calcaneal apophysitis or “Sever’s Disease” is very common in cleated shoe participation, seen frequently in soccer. Irritation at the calcaneal apophysis can cause significant disruption in ability to run. Some mild pain following activity is frequently associated with this. Stretching, ice, intermittent anti-inflammatory medications over the counter type not unreasonable, and a non-cleated shoe is of significant benefit. A turf shoe provides a slight heel elevation with some cushioning and can be of benefit. If there is a significant amount of running or continuous training, this seems to aggravate these conditions in athletes that are doing the training in a cleated shoe seem to be more predisposed; therefore, when doing conditioning or aerobic work-outs either before or after practice or training sessions, switching to a sneaker or practicing in a turf shoe on a regular basis may be of benefit. Achilles stretching is also of help and using a slight heel lift in their shoes, which they wear for activities of daily living, may be of benefit in addition. Both of these conditions are relatively self-limiting and tend to resolve over time, although some athletes with fragmentation of the tibial tuberosity apophysitis may have a prominence of their apophysitis and have some anterior knee sensitivity even into adulthood.

In the upper extremities it is not infrequent to see shoulder pain in young tennis players or throwing athletes. They frequently have pain more about the proximal humeral physis. They also may have radiographic widening over time. Refrain from throwing of up to three to four months is required if radiographic widening of the physis is noted. They do not develop a significant incidence of rotator cuff tears or instability problems. Again close attention to the number of throws is important with regard to historical findings and year-round participation, as baseball has become a year-round sport, even for the preadolescent. In addition, Little Leaguer’s elbow is a common condition, which is associated with fragmentation of the medial epicondyle as well as widening and associated medial-based elbow pain. This may be a harbinger of prolonged elbow symptoms and certainly changes in throwing technique, number of throws, or position change are prudent, as well as relative rest from throwing to allow for complete resolve of condition and maintenance of mild loss of elbow extension, which is frequent. Other associated frequent upper extremity injuries are premature physal closure at the wrist seen in gymnasts, repetitive upper extremity loading activities that can cause premature physal closure of the radius and a relative Madelung’s type deformity with noted wrist pain. Wrist pain of short duration without radiographic changes within two to three weeks or relative rest from overhead activities typically will lead to resolve of condition, so close observation in this setting is prudent.

CONDITIONS OF MULTIPLE ETIOLOGY

Osteochondritis Dessicans, a condition that has an uncertain exact etiology, typically occurs when there is some change or alteration in the blood supply to a specific physal or epiphysal area. It is commonly associated with repetitive activities at that site, such as jumping and landing, and running activities with regards to the knee and throwing activities or upper extremity loaded activities, such as gymnastics, in the elbow. Typically observation and modification of activities until skeletal maturity improves prognosis, especially with regard to the knee and weight bearing locations in addition at the ankle.

With regard to care of osteochondritic lesions of the elbow, mechanical based symptoms warrant early treatment and removal of fragmentation. Fixation of lesions in the elbow does not appear to provide for significant benefit and may actually be detrimental to elbow function in the future. With regard to the knee, early fixation may be of benefit in the athletic population, especially with any type of effusions or mechanical-based symptoms and athletic demands, although certainly there is a significant correlation with skeletal maturity and those athletes that have not reached skeletal maturity and have no mechanical symptoms may warrant just a slight modification in activity and observation and have an improved prognosis.

LOW BACK PAIN

Low back pain in the preadolescent athlete warrants close scrutiny, especially of longer than three weeks duration. In the slightly older athletes, evaluation for spondylolysis is prudent with a very high occurrence of 60-70% in young athletes with back pain. This is somewhat outside the preadolescent athlete's age group, although it can occur in young gymnasts. It is being seen more frequently now in baseball players with rotational type activities on a repetitious basis. It also had previously been noted frequently in down lineman in football with a high occurrence rate.

With regard to general back pain in a young athlete, certainly ruling out inflammatory conditions, diskitis versus infectious processes, are prudent. CBC with differential, sedimentation rate or C-reactive protein, especially if febrile occurrences occur or other associated joint swellings are present it is of importance. In a slightly older age group, SPECT type bone scans are very sensitive for evaluating for spondylolysis. Treatment primarily involves activity modification and lumbar stabilization exercise. For those patients who stay symptomatic with those modifications or have pain with activities of daily living may want to consider brace use. There may be some relative benefit of brace use for healing of spondylolytic defects.

OSTEOCHONDROSES

Osteochondroses involve abnormal endochondral ossification. There is necrosis followed by regeneration of ossification centers. These are in three categories: articular, nonarticular, and physeal. They can frequently be painful. They are usually self-limiting, especially if there is no articular involvement. Conditions involving the articular surface, such as Legg-Calve'-Perthes disease, are of significant concern and can lead to disability. Most, though, are self-limiting, such as Iselin's Disease involving the secondary apophyseal center of the base of the fifth metatarsal seen frequently in dancers and Kohler's Disease involving the tarsonavicular. It is important and frequently seen in this age group, injuries that involve a supination injury to the ankle and sometimes difficult to differentiate a secondary ossification center and apophysitis versus a true fifth metatarsal fracture. The metatarsal fractures themselves are typically perpendicular to the shaft of the metatarsal, whereas the secondary ossification centers run parallel to the shaft. This is a helpful differentiating feature radiographically.

Another condition that is of significant importance is a slipped capital femoral epiphysis. Typically, these children are overweight and appear younger than their chronological age. They present not infrequently with

thigh and knee pain and a limp with decreased range of motion of the hip seen and pain at the extremes of range of motion. Stable slipped capital femoral epiphysis are seen in individuals that are still able to weight bear. Unstable slips are classified by those individuals who are unable to weight bear. Early recognition is of paramount importance, as complications with delayed recognition can include avascular necrosis and significant early hip arthrosis as well as deformity. In situ screw fixation is primarily used for treatment, especially in stable slips. In stable slips that are treated with fixation, once epiphysiodesis occurs athletes can return to sports participation, even contact type sports. Individuals who have bilateral slips as well as those under age 10 probably warrant endocrinologic evaluation for underlying conditions preexisting in the slipped capital femoral epiphysis. The primary component in most slipped capital femoral epiphysis is increased shear stresses at the zone of hypertrophy of the physis related to activity in individuals who have increased body weight.

KEYS TO CARE OF PREADOLESCENT ATHLETES

To provide objective information. The anecdotal information abounds. It is important to be able to provide scientific-backed information to provide for care of these athletes.

Be knowledgeable regarding the organized sports environment, year-round play, elite athletes, and significant time and money put into these athletes to develop their skills.

Spend time with the patients. Parents as well as the patients have high expectations. A thorough physical examination and history of sports specific information is of paramount importance.

Allow return to sports in a timely manner without risking further injury. Don't just say "No Play." Try to incorporate rehabilitation or modifications in activities to allow for some continued participation and involvement with the team or with individual sports activities. This requires significant knowledge of the sport. It can be very beneficial to have a certified athletic trainer to assist you with regard to these activity modifications and goals as well as rehabilitation towards return to play without significantly placing the preadolescent athletes at risk for injury.

To disseminate education information, attend events, interact with parents, coaches, and administrators to assist and provide for knowledge-based information for care of the preadolescent athlete.

BIBLIOGRAPHY

Texts/Recommended References

- Pediatric and Adolescent Sports Injuries, Diagnosis, Management and Prevention. *Clinics in Sports Medicine.* Oct 2000.
- Reider B. Sports Medicine: The School-Age Athlete. Philadelphia, PA, WB Saunders Co., 1991.
- Stanitski C, DeLee J, Drez D. Pediatric and Adolescent Sports Medicine. Vol 3. Philadelphia, PA, WB Saunders Co., 1994.
- Sullivan G. The Pediatric Athlete. *American Academy of Orthopaedic Surgeons Seminar.*

Articles

- Guy JA, Micheli LJ. Strength Training for Children and Adolescents. *JAAOS.* 2001; 9(1):29-35.
- Kibler WB, Chandler TJ. Sport-Specific Conditioning. *Am J Sports Med.* 1994; 22(3):424-431.
- Matelic TM et al. Acute Hemarthrosis of the Knee in Children. *Am J Sports Med.* 1995; 23(6):668-671.
- Stanitski, C. Correlation of Arthroscopic and Clinical Examinations with Magnetic Resonance Imaging Findings of Injured Knees in Children and Adolescents. *Am J Sports Med.* 1998; 26:2-6.