Special Article

Pediatric and Adolescent Elbow Pain

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Tennis, badminton and golf are popular among Thai. These sports involve a function of elbow joint movement. An overuse or over practice of elbows can cause joint pain. As some of the players have started these sports early in their young age aiming to achieve a high success or professional career, the incidence of elbow injury and pain in children and adolescent are increasing. Many times that elbow pain is ignored or neglected by the patients themselves, their parents and coaches, or even health care professionals due to a lack of knowledge and awareness of this disorder as well as the complex anatomical structures of elbow in this age group. The delay in diagnosis of elbow pain has a negative impact on treatment outcomes. The purposes of this review are to describe basic knowledge of pediatric and adolescent elbow pain including pathophysiology, common clinical presentation, and treatments.

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As result of increasing participation in recreational or professional youth sports, sometimes as early as 5 to 6 years old[1], the incidence of elbow pain in children is increasing. Elbow pain can result from acute or chronic injuries[2]. Some particular sports especially baseball has 30 to 40% incidence of elbow injuries of various types e.g. medial ulnar collateral ligament injury, osteochondritis dissecans, and etc[3-5]. Other popular sports, for example, tennis, golf and badminton can also cause elbow injuries similar to those found in baseball. Individuals who start these sports early in their lives have higher risk of elbow injuries and pain because of the complex anatomy of immature skeletal including open physis, low muscle strength and flexibility. Aside from the age onset, the location of pain is very helpful to guide for a diagnosis of pediatric and adolescent elbow pain. In this review, the diagnostic approach of elbow pain according to the anatomical locations of pain which are classified as medial, lateral and posterior side of the elbow as well as their treatment are described.

The medial elbow pain

The medial side of the elbow is comprised of medial epicondyle, ulnar collateral ligament and flexor-pronator muscles. Medial elbow stability is formed by ligament and muscular attachments. Among the 3 components of ulnar collateral ligament [UCL] of anterior oblique, posterior oblique and transverse fibers, the strongest of which is anterior oblique fiber[6]. All of these structures can be a cause medial elbow pain. Various disorders causing medial elbow pain are the followings.

Medial apophysitis/little league elbow

The medial apophysis which appears at age 4 to 5 years old is generally the last apophysis to close[7]. Children who have immature skeletal and who have repetitive valgus force to their elbows as found in throwing athletes, tennis players and gymnasts are at particular risk for medial apophysis injuries[8]. The open physis which is weaker than its surrounding bone and ligaments can result in traction and pulling of the medial epicondyle by the UCL and flexor-pronator muscles injury from repetitive valgus force. This mechanism can cause several types of medial elbow pain aside from the medial epicondyle apophysitis, such as, avulsion fracture of the medial epicondyle, osteochondritis dissecans of the capitellum and radial head, ulnar collateral ligament tears and apophysitis of the olecranon which are collectively called by some authors as “Little League Elbow”.

Patients with medial apophysitis usually have

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pain on medial aspect of the elbow only when they have activities in early phase. If left unrecognized and untreated, the pain would be progressive and could occur even at rest in severe cases. Examination of the elbow may demonstrate swelling and tenderness around the medial epicondyle[9]. Mild elbow flexion contracture may be present. The radiographic features are usually normal in early phase whereas a widening of the apophysis as well as fragmentation, hypertrophy or deformity of the epicondyle can be found in chronic cases[10]. Treatment starts from a period of rest and avoid aggravating activities for approximately 4 to 6 weeks. Non-steroidal anti-inflammatory drugs [NSAIDs] and ice can be used for pain relief. Elbow and shoulder strengthening exercises and physical therapy are also recommended.

Medial epicondyle avulsion fracture

In an older age group of children, the medial epicondyle avulsion fracture is also reported[11-14]. Before fusion of the medial epicondyle, this physis is a weak point when significant valgus force is applied to the elbow. This fracture often occurs in boys at ages of 9 to 14 years. The most common mechanisms of injury are direct trauma or elbow dislocation. Hard throwing also induces this fracture.

Examination of the affected elbow reveals local swelling of the medial epicondyle, ecchymosis and tenderness upon palpation. The elbow range of motion is also decreased. The plain radiography shows widening of physis or medial epicondyle fracture. Internal and external oblique views are helpful to determine degree of displacement which would guide to treatment modalities[15]. Non-displaced fracture or minimally displaced fracture which is typically <5 mm-displacement are treated by immobilization with brace, long-arm cast or sling for 1 to 3 weeks[16] followed by a period of rest and avoiding valgus stress to the elbow. A displaced fracture >5 mm which is usually seen at antero-inferior to the medial epicondyle should be treated with surgery[1] . Screw fixation is also an option when there is the bony displacement[7].

Ulnar collateral ligament injury

In late adolescence, the UCL is more susceptible for injury than a physis. The important function of the UCL is as a primary stabilizer from valgus stress to elbows[17]. Acute forceful or chronic repetitive valgus stress to the elbow can precipitate the UCL injury with the same mechanism. Some particular sports predispose to this type of injury e.g. javelin thrower, water polo, baseball or gymnastics[18].

Elbow examination usually reveals tenderness along the course of UCL from medial epicondyle to the sublime tubercle of ulna. The valgus stress test with elbow flexion at 30° provokes pain or opening of medial joint space with soft or absent end-point[7]. The modified milking maneuver or moving valgus stress test also induce elbow pain. The moving valgus stress test as proposed by O'Driscoll is considered positive when the patients have pain while moving and applying valgus force to the elbow between arcs of 70 to 120°[19]. The x-ray radiography may show avulsion fragments in acute setting or calcification in chronic situation. The magnetic resonance imaging [MRI] is better than plain radiography to assess partial or complete tear of the UCL. Treatment should be individualized depending on multiple factors, such as, demanded activity, dominant hand, level of sports participation and degree of injury[1]. Conservative treatment includes a period of rest, NSAIDs or physical therapy. Surgical treatment by UCL reconstruction is only indicated with failure of conservative treatments.

The lateral elbow pain

Injuries to the lateral structures of the elbow, including radio-capitellar joint, radial head, capitellum, lateral epicondyle, lateral ulnar collateral ligament [LUCL] and common extensor muscles are potential sites of lateral elbow pain. Cartilage problems are the most common causes of lateral elbow pain in pediatric and adolescence. The differential diagnoses generally depend on the age of onset.

Osteochondritis dissecans [OCD]

Osteochondritis dissecans [OCD] is an acquired subchondral bone lesion which is the most common cause of lateral elbow pain in adolescent athletes[20]. The lesion has various clinical patterns e.g. bone resorption, fragmentation, and sclerosis. OCD at elbow mostly affects the capitellum but can also involve the radial head, olecranon and trochlear[21,22]. The typical case of capitellar OCD is a child with ages of 11- to 17-year who has repetitively overhead activities of elbow, for example, baseball pitcher, javelin, gymnastics or weight lifting[21,23-25]. The prevalence of capitellar OCD in baseball players is approximately 2 to 3%[23,26]. Risk factors of OCD are younger age at start and longer duration of activities.

Multiple etiologies of OCD have been proposed. Schenck et al[27] presented the biomechanical cadaveric study of the radial head and capitellum. Their

study showed stiffness of the capitellar articular surface decreasing from medial to lateral. Moreover, the central portion of radial head is stiffer than the lateral capitellum. The mismatch under repetitive loading activities of the radiocapitellar joint may precipitate OCD[27]. Haraldsson et al reported that the capitellum only has 1 to 2 vascular supply from the posterior aspect without metaphyseal collateral flow. This limited blood supply to the capitellum may be compromised with repetitive stress or trauma, resulting in OCD.

The presentation of OCD is progressive activities-related lateral elbow pain in children. They may have stiffness especially a loss of extension. The mechanical symptoms such as clicking or catching may refer to loose bodies in the joint. Physical examination reveals swelling and tenderness at radiocapitellar joint with limited extension (15 to 30 degrees). The flexion contracture is more common in advance cases[28]. The active radiocapitellar compression test by asking patients to actively pronate and supinate with full extended elbow can elicit the symptoms.

The initial plain radiography of the elbow often supports the diagnosis of OCD. Standard AP and lateral views may reveal lesions of the capitellum, mostly on anterolateral aspect. These lesions include lucent area, flattening, sclerosis or fragmentations. Sometimes, intra-articular loose bodies can be seen. There are many for a diagnosis of OCD, such as, Minami, Berndt and Harty, Ferkel and Sgaglione, and Anderson. Nevertheless, none of these classifications has the best interobserver agreement[29]. Kijowski and De Smeet reported that plain radiography has poor sensitivity for diagnosis of OCD. Only 66% of their patients were accurately diagnosed of OCD base on initial radiography[30]. The additional AP view with 45° elbow flexion may improve the ability to detect early OCD lesions[31]. MRI is another modality of choices for early detection which can also for evaluate the severity of OCD[20]. The MRI can precisely evaluate the size, fragmentation and displacement of OCD lesions. Furthermore, it is able to identify the joint stability. Computer tomography (CT scan) also provides useful information to estimate an extension of lesions and to detect loose bodies[7]. Taking into account the harm of radiation exposure of radiography and the high cost of MRI, ultrasonography was also reported for early detection of OCD lesions in young athletes and is found to have a good correlation with MRI[23].

Treatment for OCD of the capitellum depends on the stage of lesion[7]. Stable lesions which are evidenced as open growth plate, good elbow range of motion and simply flattening of the subchondral bone on radiography are suitable for non-operative treatment including rest, avoidance of aggravate activities, NSAIDs and range of motion exercise. Operative treatment is reserved for stable lesions which fail conservative method and in unstable lesions with closed growth plate, restrict elbow motion (more than 20 degrees), and with fragmentation or loose bodies formation. Many options of surgical procedures have been described such as arthroscopic removal of loose bodies, abrasion chondroplasty, retrograde drilling, microfracture, in situ fixation, osteochondral autograft transplantation and costal osteochondral transplantation[21,32–38].

Panner's disease

OCD of the capitellum must be distinguished from Panner's disease which is characterized by osteochondrosis of the capitellum[21,32]. Panner's disease affects only immature skeleton in children younger than 10 year-old without history of trauma. The disease is hypothesized to be the result of ischemia event during a vulnerable period of ossification, similar to Legg-Calves-Perthes disease of the hip[1]. Unlike OCD of the capitellum, Panner's disease is self-limited condition[20].

Patients present with lateral elbow pain or activity-related elbow pain. Physical examination shows swelling and tenderness at lateral aspect of the elbow or radiocapitellar joint with limited range of motion. The active radiocapitellar compression test may be positive like OCD of the capitellum. The diagnosis is confirmed by irregularity, fragmentation or sclerosis of the entire capitellum of the elbow without loose bodies from radiography. The treatment is mainly conservative with expecting recovery time within 1 to 3 years[39]. Treatments consist of stopping or refraining from aggravated activities. Elbow splint for a short duration is helpful to relieve pain[40].

The posterior elbow pain

The posterior structure of the elbow consists of the olecranon which is an insertion site for triceps tendon. The olecranon apophysis typically appears at age 9 to 10 years old and does not close until approximately 5 to 6 years of age.

The olecranon apophysitis/olecranon stress fracture

Before a complete ossification of the olecranon apophysis, there is susceptibility for olecranon injuries[41]. Repetitive forceful triceps contraction as in

some particular sports, such as, javelin thrower, baseball, gymnastics, tennis, wresting, and archery is a potential cause of olecranon apophysitis or stress fracture.

The symptom is localized pain on the olecranon and distal triceps tendon. Triceps-contraction activities can provoke pain. Physical examination shows tenderness over the olecranon and worsening of pain when doing resisted triceps contraction[7].

Lateral radiography of the elbow reveals presence of the olecranon physis with possible widening or sclerosis of the surrounding epiphyseal plate. The widening physis has better prognosis than sclerosis[42]. Furushima et al described 5 types of olecranon stress fractures including physeal, classic, transitional, sclerotic and distal[43].

The treatment for olecranon apophysitis or non-displaced olecranon stress fracture is usually conservative method which is rest, activity modification, NSAIDs or bracing. For displaced fracture, the surgical fixation is required.

The olecranon bursitis

This condition affects children by acute or chronic trauma to the elbow[2]. Physical examination shows significant swelling and tenderness over the dorsal aspect of the olecranon. The treatment is mainly conservative with rest, ice compression and NSAIDs. Occasionally, corticosteroid injection into the olecranon bursa may need to relieve inflammation. It rarely requires surgical treatments or bursectomy.

The valgus extension overload syndrome

This condition often affects late adolescent who participate in particular sports, such as, overhead throwing or boxing. Repetitive hyperextension of the elbow results in shearing and distraction force on the medial aspect of the elbow and compressive force on the lateral aspect or radiocapitellar joint of the elbow. The typical patterns are ulnar collateral ligament injury, radiocapitellar compression with posteromedial olecranon osteophyte[7].

Physical examination reveals pain when full elbow extension with applying valgus force and tenderness over the medial border of the olecranon fossa[44]. Elbow flexion contracture is frequent. The arm bar test may be positive by asking patients to extend the elbow and internally rotate the shoulder while placing the dorsum of the hand on examiner's shoulder then the examiner places downward pressure over the olecranon and distal humerus to stimulate forced extension[1]. The radiography may reveal osteophyte or loose bodies[8]. CT scan clearly shows bony pathology including osteophyte. On the other hand, MRI is useful to differentiate complete or partial tear of the UCL.

Conservative methods including rest, activity modification or steroid injection should be the first line treatment. After failed conservative treatment, the surgical treatment is considered. The surgical procedures consist of arthroscopic debridement and treatment of UCL tear.

Conclusion

The diagnosis of pediatric and adolescent elbow pain can be made by age onset of the patients and anatomical locations of pain. Elbow pain can occur in various types of sports with many precipitating activities. The treatment of elbow pain is primarily non-operative method whereas operative treatment can be used in the patients who fail medical or conservative treatment.

Potential conflicts of interest

The authors declare no conflict of interest.

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