Valgus Extension Overload Syndrome: Review

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Abstract

Valgus extension overload syndrome of the elbow is common among throwing athletes and commonly results from repetitive valgus torque and deceleration across the elbow occurring during the late acceleration and early follow-through phases of the throwing motion. Non-operative treatment consisting of rest, anti-inflammatory medicine, correction of improper throwing mechanics, and a rehabilitation program to strengthen and coordinate the muscles should be tried first. Failure of non-operative treatment is an indication for open or arthroscopic removal of osteophyte and posteromedial decompression. Literature is divided regarding amount of olecranon resection to be done in posteromedial decompression but still it goes more in favor of removing only osteophytes in VEO syndrome.

Keywords: Valgus extension overload syndrome • Valgus torque • Arthrodesis • Anti-inflammatory medicine.

Introduction

Valgus extension overload describes a group of pathologic conditions of the elbow that result from repetitive valgus torque and deceleration across the elbow occurring during the late acceleration and early follow-through phases of the throwing motion. The resulting high compression and shear forces act on the posteromedial olecranon and posteromedial trochlea, causing ''posteromedial impingement ''. Pathologic changes involving the olecranon include proximal stress reactions, a posteromedial tip stress fracture, a transverse proximal process stress fracture, marginal osteophytes, marginal fragmentation, and intra-articular loose bodies. While pathologic changes involving the posteromedial trochlea includes synovitis, chondromalacia, chondral flaps, osteochondral lesions, subchondral erosion, subchondral insufficiency fractures, and marginal exostosis. Which over time, may fracture, leading to loose bodies formation and mechanical symptoms [1].

It is commonly seen in the throwing or overhead athlete. However many throwers and overhead athletes never get to the point of having a clinical problem with VEO because they discontinue throwing in high volumes as a result of increasing age and decreasing opportunity to play competitive overhead sports beyond adolescence and early adulthood. In contrary to that, higher-level athletes, and those who continue to enjoy overhead sports into adulthood, the likelihood of developing symptomatic VEO is increased .In addition to this, athletes involved in swimming, volleyball, gymnastics, racquet-sport and golfers can also suffer from VEO [2].

Biomechanics and Pathology

During a throwing motion-in baseball for example-the elbow moves during late cocking and acceleration phases from 110° to 20° of flexion with velocities up to 3000°/s. During this, combination of valgus and rapid extension forces creates a tensile force along the medial side, compression on the lateral portion of the elbow, and shear forces in the posterior compartment. This combination is called ''valgus extension overload'' syndrome and it forms the basic pathological model behind most injuries in the athlete's The elbow joint is a hinge joint and the bony ulnohumeral articulation provides stability at the extremes of motion, from 0 to 20 of flexion and beyond 120 of flexion. The intervening 100, which is the primary arc of motion used in overhead throwing, relies progressively on the static and dynamic soft tissue restraints to provide stability. Toward 90 of flexion, the anterior bundle of the MCL assumes a greater relative role as the anterior capsule becomes lax in this position and anterior bundle of the MCL has been shown to provide 54% of the stabilizing force against a valgus stress [3-5].

Ahmad et al [6] in his biomechanical study suggested that MUCL insufficiency is a primary pathologic component in the development of posteromedial osteophytes and any injury that creates even the smallest increase in medial laxity may eventually lead to VEO. He also successfully showed contact area between the posteromedial trochlea and olecranon decreased, and pressure increased with increasing MUCL insufficiency for all ligaments and loading conditions for each elbow flexion angle.

After knowing the biomechanics and pathology in VEO a common question arises in mind that why VEO happens in some athletes and not in all. In 2009 Aguinaldo and Chambers tried to answer this question to some extent in which they studied sixty-nine adult baseball player's body kinematics pitching on an indoor mound by 3-dimensional motion analysis. They calculated thirteen biomechanical variables and extracted them for regression analysis to investigate their associations with elbow valgus load. From that they concluded that apart from usual pathology several individual mechanical factors in throwing motion also predispose the elbow to high valgus load. These factors include late trunk rotation, reduced shoulder external rotation, and increased elbow flexion. They also concluded sidearm pitchers were more susceptible for developing VEO than overhand pitchers [7].

Apart from this, as already mentioned VEO is a group of pathological condition that result from extension and valgus overload, Cain and associates provided elegant description on the sequelae of this overload syndrome i.e. Repetitive tensile loads experienced by the anterior bundle of the MCL at forces near the point of failure may eventually lead to ligament attenuation or failure. The valgus overload is then accentuated, and excessive valgus moments may lead to stretching of the other medial structures, resulting in ulnar neuritis, flexor-pronator mass tendonopathy, or medial epicondyle apophysitis [8].

Diagnosis

As with any syndrome diagnosis is made on the basis of history, examination and relevant investigation, likewise in VEO syndrome these 3 things helps in diagnosis

Clinical presentation

Patients have a history of throwing or other repetitive overhead activities and often report most commonly with posteromedial elbow pain during the extension or follow-through phase of throwing. Decrease in pitching velocity and control as well as early fatigue can also be the presenting complaint. However, if an athlete presents with locking or catching during throwing it suggest the presence of loose bodies or articular cartilage injury. Athletes can also give a history of previous MUCL injury, ulnar neuritis, and subluxation of the ulnar nerve out of the cubital tunnel [9].

Examination of elbow in such athlete will show posteromedial tenderness and/or synovitis with possible associated extension loss and/or UCL laxity. The arm bar test is positive which is performed with the arm in full internal rotation at 90 degrees of forward flexion with the hand on the examiner's shoulder. The patient's olecranon/distal humerus is pulled down to re-create full extension. Reproduction of the posterior or posteromedial pain is considered a positive test finding.

Apart from this, evaluation of medial stability is the cornerstone in the assessment of the overhead athlete with valgus extension overload. The moving valgus stress test and the milking maneuver is two tests routinely used to assess medial stability. Moving valgus stress test: Starting with the arm in full flexion, the examiner applies a constant valgus force to

the elbow and then quickly extends the elbow. The patient experiences reproduction of his painful symptoms with an apprehension-like response in an arc as the elbow passes from 120 of flexion to 70 of extension. Milking maneuver: Having the patient reach under his injured arm with the opposite hand and grab the thumb of the injured arm performs the milking maneuver. Continued pulling will place a valgus stress on the elbow under examination. Of note, the clinician should palpate the MCL in approximately 60 of flexion, to move the flexor pronator mass anterior to the fibers of the anterior band [10]. Investigation: Routine x-rays of elbow AP, lateral, and two oblique views in 110 of flexion are generally very useful to identify posteromedial olecranon osteophytes or evidence of traction injury to the medial epicondyle. Along with that computed tomography scan with sagittal and coronal reconstructions can be used for visualizing overall morphological changes, including stress fractures, avulsion fractures as well as osteophytes and loose bodies [11].

In addition to that, dynamic ultrasound of the elbow has proven to be very useful in real-time evaluation of the moving elbow and assessment of MUCL [12]. However, magnetic resonance imaging (MRI) scan with or without intra-articular contrast is conferred to be the gold standard imaging modality for the athlete's elbow. MRI findings of Posterior trochlea/anterior olecranon chondrosis , insertional tendinosis at the medial border of the triceps, sometimes with subenthesial bone marrow edema in the olecranon, were common and may serve as an imaging clue for VEO. Apart from this other associated findings may include loose bodies, chronic changes to the UCL, as well as flexor/pronator tendon origins [13,14]. However Kooima et al [15] has showed these findings can be present in asymptomatic baseball players also, which undermines the importance of correlating history and examination with imaging studies to come at diagnosis of VEO. Also with careful clinical history one can distinguish between VEO and UCL insufficiency, as throwing athletes with MRI changes to the olecranon but pain in the early acceleration phase of throwing are more likely to have UCL insufficiency. Whereas those throwing athletes with similar MRI changes but pain during full extension and the follow through phase of throwing are more likely to have posteromedial impingement.

Treatment and Controversy

Treatment of valgus extension overload injuries includes conservative management or surgical treatment. The non-operative treatment for valgus extension overload injuries includes rest, anti-inflammatory medicine, correction of improper throwing mechanics, and a rehabilitation program to strengthen and coordinate the muscles acting across the elbow. Waris et .al in 1946 first reported nonoperative treatment of medial elbow impingement in javelin throwers and in his study all 17 throwers were able to return to sports after rest and a rehabilitation program [16].

However that study was a retrospective clinical study and diagnosis was made purely by clinical examination at that time. Surgical treatment is indicated for the patients who have persistent symptoms despite nonsurgical treatment and a desire to return to the same level of competition. In 1959, Bennett reported olecranon osteophyte formation in pitchers and described several cases in which patients were treated successfully with open excision. Based on this experience, he recommended open surgical excision for symptomatic lesions [17]. However, it was Rosenwasser and Steinmann who published first report on arthroscopic debridement for posteromedial impingement. In their study Eighty-three percent of patients reported improvement at an average 26-month follow-up, and all 83% were able to return to sport at 6 months postoperatively [18]. From then numerous reports from various author showing excellent to good result from arthroscopic ebridement in posterior impingement has been published [19-21].

Arthroscopic removal of the olecranon osteophytes along with small part of posteromedial olecranon has been widely used as treatment for posterior elbow impingement. Theoretically, decreasing the secondary stabilizing action of the ulno humeral articulation by resecting portions of the proximal medial olecranon should result in an even greater proportion of the appli valgus stress being absorbed by the anterior ulnar collateral ligament. It is also well known that excessive surgical resection of the olecranon during posteromedial decompression increases valgus instability [22]. However, there is controversy regarding how much resection is acceptable. On reviewing literature regarding amount of olecranon to be resected in valgus impaction syndrome, we didn't found any clinical study comparing outcomes after different amount of olecranon resection but in a study by Andrews and Timmerman [23] in 72 professional baseball players with arthroscopic and open elbow surgery, he showed around 42% of his patients required a second operation, either in the form of repeat debridement or UCL reconstruction. Based on their observation they concluded that all patients who underwent partial olecranon excision for posterior impingement did not have universally excellent results.

Similarly Fideler et al [24] while reviewing the experience at the Kerlan-Jobe Clinic reported that around 10% of patient required a later UCL reconstruction after posteromedial decompression and 26% of athletes not able to return to their preoperative level of sports.

We tried to analyze this reports on the basis of already done biomechanical study on UCL strain and olecranon resection. However biomechanical study had compounding reports regarding effect of olecranon resection on UCL. Kamineni et al in his biomechanical study showed with increase in flexion angle and valgus torque, resection of ≥ 6 mm led to an increase in strain in the anterior bundle of the medial collateral ligament. The also showed non-uniform change in strain related to 3 mm of resection suggesting resections of the posteromedial aspect of the olecranon of 3 mm may jeopardize the function of the anterior bundle. Through this study they suggested to remove only olecranon osteophytes in VEO patients [25]. However Andrews et al, lee et al and Levin et al. in three different biomechanical studies suggested that at moderate quasistatic valgus loads, ulnar collateral ligament strain is not significantly increased with increasing amounts of posteromedial olecranon resection [26-28].

Levin et al also suggested if removing 4 to 8 mm of posteromedial olecranon (which is normally done in routine posteromedial decompression surgery) is putting significant strain in UCL then result of some retrospective clinical study [29] showing only 5% of patient had previous posteromedial decompression surgery out of total patient requiring UCL reconstruction would have been much higher.

From the above it can be concluded that surgeons right now have divided opinion over amount of olecranon resection in VEO syndrome. The author believes that VEO and UCL injuries are in the same spectrum of injury and likely occur concurrently in many throwers. Literature regarding how much olecranon resection can be done safely is not clear but still from the available literature, author recommend to remove only osteophytes in posteromedial impingement, as right now we don't have any clinical study regarding long term effect of olecranon resection in VEO syndrome.

Conclusion

It has already been reported that VEO is the most common diagnosis requiring surgical treatment in baseball players as well as in other overhead throwing athletes, but still there is not a single clinical study which compares outcome after posteromedial decompression with and without olecranon resection in VEO syndrome. Through this article we tried review VEO syndrome and tried to make treatment recommendation, but unfortunately, this article also draws attention to the deficiency of high-level studies in VEO. Therefore we encourage clinicians and researchers to conduct studies of VEO with higher levels of evidence.

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