Editorial

Arthur Jason De Luigi*, DO, MHSA

# The role of osteopathic principles and practice in upper extremity injuries of the overhead athlete

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Upper extremity injuries are very common in overhead athletes. Shoulder and elbow pain frequently occur in the youth, adolescent, and adult overhead and throwing athlete population. Specific shoulder and elbow injuries in the overhead and throwing athlete will vary from sport to sport. Athletes who participate in overhead sports, such as baseball, tennis, and volleyball, most commonly experience upper extremity pain. An injury surveillance study on shoulder and elbow injuries in youth baseball players noted that between 26 and 35 out of 100 youth baseball pitchers experienced a shoulder and/or elbow injury during the course of a season [1]. A different study looking at pitch count, pitch types, and pitching mechanics found that 30 % of youth baseball pitchers reported shoulder pain and 25 % reported elbow pain after a game [2]. In other overhead sports, an injury surveillance study of elite adolescent national tennis players (boys and girls 16–18 years old) reported that more than 25–45 % of all injuries were located in the upper extremity [3]. Further evaluation of these athletes revealed that 25 to 30 % had previous or current shoulder pain, whereas 22–25 % had previous or current elbow pain [3]. A retrospective epidemiology study of pediatric volleyball injuries treated in United States Emergency Departments over a 20-year period captured 692,024 reported injuries, of which injuries to the upper extremities was the most common, accounting for 48 % of all injuries [4]. It is clear that upper extremities are at risk for injury; however, osteopathic physicians are inherently trained through their holistic approach during pre-participation examinations (PPEs) or longitudinal in-season evaluations to identify modifiable risk factors and reduce the frequency and severity of these injuries.

## Risk factors for upper extremity injury

The potential internal and external risk factors for upper extremity injury vary between different overhead sports. Specific external risk factors for the throwing athlete include the number of pitches thrown in a game, the type of pitches, and the number of months pitched in a year [5, 6]. Additionally, there is an unaccounted workload from the warmup pitches off the mound. Zaremski et al. [7] conducted the first study that counted all pitches thrown off of the mound for a pitcher on game day and found that the volume of pitches reported during a game is 42 % less than the actual pitches thrown on game day. The findings from these studies have led to rule changes and recommendations to limit the pitch count to less than 80 throws per game, pitching for less than 8 months in a year, and limiting the use of curve balls and sliders [8].

There have also been studies looking at internal risk factors that may alter overhead mechanics and increase the risk of injury. For example, the shoulder (glenohumeral joint [GHJ]) capsule is the most mobile joint in the body and, if restricted, can cause issues in overhead athletes. One of the primary risk factors for overhead athletes is the repetitive nature of performing the same or similar motions repeatedly. An extensive systematic review of risk factors for shoulder injuries in overhead athletes was conducted and included studies for numerous overhead sports, such as baseball, swimming, tennis, volleyball, badminton, handball, and water polo [9]. The findings identified numerous modifiable internal risk factors, such as range of motion (ROM, lack or excess) and rotator cuff weakness (isometric and isokinetic), significantly increase the risk of future injury [9]. Additionally, scapular dysfunction and dyskinesis also appear to have a link and influence for future injury [9]. A common finding in the dominant shoulder of overhead athletes, particularly throwers, is the reduction with internal rotation (IR) when compared to their

***Corresponding author: Arthur Jason De Luigi**, DO, MHSA, Physical Medicine & Rehabilitation, Mayo Clinic Arizona, 13400 E Shea Blvd, Scottsdale, AZ 85259, USA, E-mail: deluigi.arthur@mayo.edu

nondominant, nonthrowing shoulder [10]. These restrictions are frequently multifactorial due to muscular imbalances and tightness of the rotator cuff muscles and the periscapular musculature including the rhomboids, trapezius, and levator scapulae in addition to tightness in the joint capsule. The incorporation of muscle stretching and strengthening alone will be insufficient to remedy the IR deficit, so a proper regimen must include joint capsular stretches [10]. Tightness in the joint capsule can lead to compensatory changes in the periscapular musculature, which can lead to imbalances that may have a cascading effect on the elbow and forearm [10].

The previously mentioned physical impairments, deficits, and imbalances are clearly a concern for risk of injury in the overhead athlete. However, the repetitive nature of the overhead motion of these athletes makes it imperative to assess the dynamic biomechanics for changes that may propagate to injury. There are multiple studies evaluating alterations in biomechanics and the impact that biomechanics may have on the risk of developing an upper extremity injury. Studies have evaluated differences in pitching kinematics and kinetics in adolescent throwers compared to adults to identify biomechanical factors that may contribute to overuse and fatigue in these athletes [11–13]. Early kinematic studies of adolescent pitchers suggest that there is an increase in physeal width of the dominant shoulder regardless of symptoms. As the athlete matures, there are skeletal changes, which have been documented by computer tomography, such as a significant increase in humeral head and glenoid retroversion [11–13]. Despite these findings, some early studies suggest that youth athletes exhibit similar upper extremity joint kinematics compared to adult athletes. However, recent studies suggest that youth pitchers may show greater variability in these parameters compared to elite adult pitchers. Overall, it is unclear if there are specific parameters or variability that increase the risk for injury [11–13].

Understanding these factors demonstrate that upper extremity injuries in the overhead athlete are frequently multifactorial. Therefore, a comprehensive holistic osteopathic approach for evaluation and management is imperative and integral in identifying any anatomical pathologies, deficiencies, and imbalances leading to changes in the biomechanical motion of the overhead athlete. A preparticipation physical examination and evaluation should identify these issues, and the combination of offseason exercises and osteopathic treatment can help prevent injuries during the season. However, if an injury does occur during the season, the same osteopathic approach is imperative and integral to the successful treatment and rehabilitation of these injuries.

## Osteopathic approach to overhead athletes

Osteopathic physicians are uniquely trained to assess the full biomechanical chain to detect imbalances that may lead to current or future injuries. The systematic and holistic approach to treat the whole person and avoid focusing on the local area of pain and discomfort will not only help to treat the existing issues but also implement changes to avoid future problems. The early identification of imbalances can lead to early recovery as well as prevention of future problems for these athletes. The standard osteopathic TART (Tenderness, Asymmetry, Restriction of motion, Tissue texture changes) provides a foundation to the assessment of these overhead athletes. The systematic TART approach, combined with the evaluation of the entire upper extremity biomechanical chain, provides a full-spectrum assessment that is not focused only on the focal injury. Proper assessment requires evaluation of the cervical and thoracic paraspinals as well as the shoulder, periscapular area, upper arm, elbow, forearm, wrist, and hand. The osteopathic physician will be able to assess for changes in muscle tone and tissue texture of the periscapular muscles including the pectoralis, rhomboids, trapezius, and levator scapulae as well as any restrictions of the first rib. Additionally, the osteopathic physician will conduct a TART assessment of the cervical, thoracic, and lumbar spine as well as somatic dysfunction of the pelvis and sacrum. Osteopathic assessment of shoulder, elbow, and hip mobility would also be beneficial in the assessment of the overhead athlete. The physical examination will still also include standard assessments of common shoulder and elbow injuries and would include specialized tests such as the Neer's impingement, Hawkin's, Empty Can, O'Brien's, Apprehension, Cozen's, and the Elbow Valgus Stress Test. The osteopathic approach will be able to identify any focal deficits, injuries, or imbalances that may have contributed to the current injury or increase the risk for future injury if not addressed. This holistic approach to the overhead athlete is paramount for proper diagnosis and treatment. Additionally, if these assessments are performed at the time of the PPE, then this early detection can significantly reduce the risk of injury during the season. The osteopathic physician can counsel the overhead athlete regarding the findings and incorporate stretching and strengthening exercises that can prevent injury during the training period as well as throughout the season.

The efficacy of osteopathic treatments and manipulation are well documented in the literature for treating and preventing issues encountered by the overhead athletes. The

osteopathic manipulative treatment (OMT) known as the Spencer Technique was evaluated in a randomized controlled trial (RCT) vs. sham therapy in a prospective cohort of college baseball pitchers. Pretreatment evaluation was completed 1 week before the treatments and included ROM (flexion, extension, abduction, adduction, IR, and external rotation [ER]) of the dominant throwing arm, 10 maximum-velocity throws, and self-reported performance utilizing the Kerlan-Jobe Orthopaedic Clinic Shoulder and Elbow Score (KJOC-SES). Both groups had decreased IR and increased ER at initial evaluation; after treatment, there was a statistically significant improvement in IR and abduction in the treatment group [14]. Another RCT utilizing the muscle energy technique (MET) demonstrated improved posterior shoulder tightness in baseball players. The results of the 61 players revealed that MET for the GHJ horizontal abductors provided immediate statistically significant improvements in both GHJ horizontal adduction and IR ROM in asymptomatic collegiate baseball players [15]. OMT has also been shown to be effective in treating subacromial impingement in overhead athletes. A combination of techniques may be performed for treatment and rehabilitation, and this combination has demonstrated a significant reduction of pain and improvement in function over a 6-week period [16]. Another RCT with 1-year follow-up revealed that the Thoracic MET-only group demonstrated significantly greater improvement in pain and disability (Disabilities of the Arm, Shoulder, and Hand [DASH], Shoulder Pain And Disability Index [SPADI], Visual Analogue Scale [VAS] 7-day average) than placebo at discharge, 6 months, and 12 months [17].

Evaluation of the overhead athlete, either during the PPE or postinjury setting, should include a thorough osteopathic physical examination and functional assessment. The evaluation would include task-oriented functional movements to assess the biomechanics of the overhead athlete. The goal of the osteopathic evaluation would be to uncover any of the following deficits across one or multiple regions: mobility, neuromuscular control, muscular endurance, balance, and/or strength. Following the assessment, an osteopathic plan of management will be formulated by the physician to include a multi-phased treatment and rehabilitation program. The combination of osteopathic manipulation, soft tissue techniques, modalities, and a therapeutic stretching and exercise program have demonstrated to be integral for treatment, injury prevention, and preparation for a return to unrestricted sporting activity. Typically, osteopathic treatment is performed in conjunction with physical therapy and therapeutic exercises for best results. The treatment and rehabilitation program should focus on strength, mobility, endurance, and power, and should also include core control and lower extremity strength training. Osteopathic evaluation and treatment are integral to the success of the injury prevention and treatment of the overhead athlete. The incorporation of osteopathic physicians into the sports medicine team for collegiate, amateur, and professional overhead sports should become a medical standard of care.

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