



BASIC SCIENCE

Premature cystic lesions in shoulders of elite junior javelin and volleyball athletes: a comparative evaluation using 3.0 Tesla MRI

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Background: The purpose of this study was to evaluate clinical and magnetic resonance imaging (MRI) findings in the shoulders of high performance competitive junior javelin athletes and volleyball players. The hypothesis was that structural lesions already exist in young and asymptomatic overhead athletes.

Methods: Thirty-one healthy high performance junior elite athletes were included. Group 1 consisted of 15 male javelin throwers (mean age, 17.7 ± 0.8 years) and group 2 of 16 male volleyball players (16.9 ± 1.0 years). Questionnaire-based interviews, comprehensive clinical examination, and shoulder scoring systems (visual analog scale [VAS] and Constant-Murley Score) were completed. Bilateral shoulder imaging was performed using a 3.0 Tesla MRI.

Results: The Constant-Murley Score of group 1 was 95.5 ± 3.6 and 94.7 ± 4.6 points for group 2. Group 1 demonstrated a mean VAS of 0.9 ± 1.6 and group 2 a mean of 0.6 ± 0.8 points. Postero-superior intraosseous cysts of the humeral head were detected in 73.3% of all javelin throwers in the dominant shoulder, but only in 13.3% in the nondominant shoulder ($P = .008$). In the volleyball group, such cyst formation was rarely seen in 12.5% in the dominant versus 6.3% in the nondominant shoulder ($P = .66$).

Conclusion: A high percentage of junior elite athletes already demonstrate osseous signs of overloading especially in the group of javelin athletes, although none had a history of prior shoulder pathology. Therefore, junior overhead athletes might be at risk for the early development of structural lesions at the insertion of the posterior rotator cuff similar to lesions already known for adult athletes, even though they do not present clinical signs of overuse at that age.

Funding: The study was generously funded by the Federal Institute for Sports Science (BISp) due to a resolution of the German Federal Parliament.

IRB/Informed Consent: The study was part of an observation performed by the Faculty of Sports and Health Sciences of the Technical University of Munich and the MRIs were part of this observation. Study participants gave informed written consent ahead of the study.

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Level of evidence: Basic Science, Anatomy Study, Imaging.
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Keywords: Javelin; volleyball; junior; overhead athletes; magnetic resonance imaging (MRI); glenohumeral internal rotation deficit (GIRD); athletes shoulder; intraosseous cysts

A wide consensus exists that repetitive loading of the shoulder joint, as seen in throwing motions, leads to functional and structural adaptations of the musculoskeletal system. Specific changes include elongation of the anterior capsule and contraction of the posterior capsule, resulting in glenohumeral internal rotation deficit (GIRD) and pathologic postero-superior impingement (PSI).^{3,4,9} Although the causative mechanisms are still controversially discussed, repetitive stresses and microlesions may ultimately result in specific injuries and degenerative macroscopic lesions such as postero-superior rotator cuff (RC) pathologies, superior labrum anterior-posterior lesions (SLAP), or alterations of the long head of the biceps tendon (LHB).^{3,7,9,16,17,25} Thus, a relevant number of affected athletes are forced to stop their careers prematurely in order to avoid long-term glenohumeral dysfunction by proceeding with their throwing activities.²⁵ Currently, the majority of recent studies have focused on baseball pitchers.³ Indeed, javelin athletes may be exposed to even heavier loads due to the higher weight of the javelin and the additional forces resulting from the approach run.^{13,25} Unlike javelin or baseball, the volleyball game requires various types of motion patterns involving repetitive, ballistic impact loads, which is therefore assumed to be an alternative mechanism causing structural alterations of the shoulder joint.^{23,28}

Magnetic resonance imaging (MRI) enables noninvasive evaluation of structural changes and identification of lesions in early stages, even in asymptomatic athletes. One study reported on a high incidence of pathologic findings in MRI up to 93% and 80% in symptomatic and asymptomatic team handball players, respectively.¹¹ Such pathologic findings included partial and full thickness tears of the RC, Bennett's lesions, SLAP lesions, and osseous alterations at the postero-superior aspect of the humeral head in comparable studies of overhead sport disciplines.^{7,11,24} Overall, the aforementioned studies found specific osseous lesions at the postero-superior aspect of the humeral head, which have been described as bone marrow edemas, cystic changes, or osteochondral lesions.^{7,11,24} Although discussed controversially, cystic lesions at the insertion site of the RC have also been correlated to tears of the RC.^{22,33}

These recent studies have included almost only senior athletes (>21 years of age), who have performed many more years of overhead athletics relative to their junior team members. Accordingly, there is a lack of evidence regarding elite junior athletes in general, and only few case reports exist on detailed imaging of asymptomatic junior athletes' shoulders suffering epiphysial growth-plate

lesions.^{2,20} Therefore, investigation of the incidence of early alterations at the glenohumeral joint is warranted to develop and improve existing prevention strategies to possibly counteract, or at least slow down the development of these alterations.

The goal of this study was to evaluate both the dominant and nondominant shoulder joints of asymptomatic elite junior overhead athletes for early structural alterations of the glenohumeral joint using native bilateral 3.0 Tesla MRI in combination with a comprehensive clinical examination. One group of elite junior javelin throwers and another group of elite junior volleyball players were investigated bilaterally. We hypothesized that the specific repetitive stress of throwing activities in high level overhead sports would have already resulted in macroscopic structural lesions and functional constraints of the shoulder joints even in asymptomatic elite junior athletes.

Materials and methods

Subjects

Thirty-one male elite junior athletes agreed to participate in this study and provided informed written consent before participation. All athletes have accomplished their specific high-level overhead sports for a minimum of 2 years and took part in national or international competitions on a regular basis at that time. Additionally, all athletes performed Olympic weight lifting and intensive strength training as part of their training routine. None of the athletes had a history of relevant shoulder trauma or surgery. Athletes were excluded, if they had suspended training because of any shoulder complaints within a period of 6 months before testing. All tests were performed in the post-season recreation time of the athletes. The number of overall available athletes was limited, since the inclusion criteria were aimed exclusively on high-level athletes in their field of competition at a specific age.

Fifteen athletes (group 1) performed javelin on a semi-professional level being part of the German Junior National Squad in javelin. All of the javelin athletes ranked within the German top 30 junior lists at the time of participation (2009-2010). At the time of clinical and imaging evaluation, the athletes have already practiced sport specific javelin training for a mean (\pm standard deviation [SD]) of 6.5 (\pm 2.2) years and a mean amount of 4.5 (\pm 2.6) specific training hours/week (excluding general strength, endurance, and conditioning training). Other sporting activities of these athletes were performed on a recreational level including pole vault (1 athlete), gymnastics (1), and volleyball (2). Previous sporting activities on a recreational level have included team handball in 2 cases.

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