

Identifying the Most Susceptible Rotator Cuff Muscle in Amateur Boxers: A Cross-Sectional Study

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ABSTRACT

Background: Rotator cuff injuries are prevalent in overhead and contact sports like boxing, where repetitive upper limb movements lead to overuse and trauma-related pathologies.

Objective: To identify the most commonly affected rotator cuff muscle among amateur boxers using clinical functional assessment.

Methods: This cross-sectional study included 184 amateur boxers aged 18–30 years from UFC gyms and university sports departments in Lahore, Pakistan. Participants had at least two years of consistent boxing experience. The American Shoulder and Elbow Surgeons (ASES) questionnaire was administered to assess shoulder pain and function. Physical assessments included the Drop Arm Test, Infraspinatus Test, Hornblower's Sign, and Gerber's Lift-Off Test, each targeting a specific rotator cuff muscle. Sensitivity and specificity of each test were considered. Descriptive statistics were performed using SPSS v25.

Results: Out of 184 boxers, 152 were male (82.6%) and 32 female (17.4%), with a mean age of 22.98 ± 3.51 years. Supraspinatus was the most affected muscle, with 72 participants (39.1%) testing positive via Drop Arm Test. Infraspinatus, subscapularis, and teres minor followed with 38.0%, 36.9%, and 26.1% involvement, respectively. Moderate to severe shoulder pain was reported by 77.2% of boxers.

Conclusion: Supraspinatus tears are the most prevalent rotator cuff injury in amateur boxers, emphasizing the need for early screening, preventive rehabilitation, and shoulder-strengthening protocols in boxing training programs.

Keywords: Athletic Injuries, Boxing, Pain Measurement, Physical Examination, Rotator Cuff Injuries, Shoulder Impingement Syndrome, Shoulder Injuries, Shoulder Joint, Sports, Supraspinatus, Tears

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Introduction

Rotator cuff injuries, involving partial or complete tears of the tendinous structures stabilizing the shoulder joint, are a prevalent musculoskeletal issue that can significantly impair arm elevation and shoulder mobility. These injuries are commonly associated with shoulder pain and muscle weakness, particularly in older individuals, and are frequently managed with conservative treatments such as rest, pharmacological pain relief, and physiotherapy. Among athletes, particularly amateur boxers, the repetitive and forceful nature of punching places substantial mechanical stress on the shoulder complex. This repeated overhead activity increases the risk of acute and overuse injuries, including rotator cuff strains and tears, which can result in chronic pain, instability, and functional limitations. Due to the high physical demands and contact nature of boxing, elevated injury rates are expected in the sport. However, the severity and frequency of such injuries have sparked ongoing debates regarding the safety of boxing as an Olympic sport (1).

Epidemiological data indicate that injuries in amateur boxing occur at an average rate of one per 772 hours of training and one every 2.5 hours of competitive participation (2). These statistics underscore the urgent need to investigate injury mechanisms and identify modifiable risk factors that could inform preventive strategies. Although there has been a noticeable decline in amateur boxing participation over the past decade, injury incidence remains concerning, especially in professional boxing settings. Interestingly, boxing does not appear to produce lasting impairments in upper limb function, specifically hand performance. However, factors such as glove size during heavy bag sessions have been implicated in the aggravation of hand-related injuries (3). The most commonly reported injuries are soft tissue contusions, though future studies are encouraged to adopt improved epidemiological methodologies and exposure metrics for more accurate injury surveillance (4).

Scapular dyskinesis, a biomechanical alteration in scapular motion has also been implicated in shoulder pathologies among boxers. This condition has been associated with structural deviations such as thoracic kyphosis, cervical lordosis, altered scapular muscle activation patterns, and diminished flexibility in periscapular musculature (5). While the removal of headgear has led to a reduction in head trauma, it has paradoxically resulted in a marked increase in facial lacerations and an overall rise in total injury count (6). Additionally, approximately 16% of hand and wrist injuries in boxing are attributed to extensor hood pathologies. These may include joint synovitis, capsular injuries, and complete tears of the extensor hood, often leading to prolonged recovery times, averaging up to 110 days and significant compromise in hand function (7).

The shoulder girdle is particularly critical in boxing due to its role in generating punch force and maintaining upper limb coordination. A study examining elite boxers from the Korean national team assessed the isokinetic muscle function of shoulder movements, including protraction, retraction, and internal and external rotation. It also evaluated the muscle tone and pain levels of the upper trapezius and infraspinatus in relation to scapular positioning, further supporting the importance of neuromuscular control in injury prevention (8). Boxing remains popular among both athletes and spectators, despite its association with frequent injuries (9). Previous surveys have sought to identify common injury profiles and contributing risk factors among boxers, with one study using a 66-item questionnaire to evaluate injury incidence over a three-year period (10).

Different punch types such as jabs, crosses, and hooks require distinct biomechanical movements. The jab, typically delivered with the lead hand, is the quickest strike due to its minimal range of motion and limited involvement of multiple arm segments (11). The scapula, acting as a biomechanical bridge between the cervical spine and upper extremity, is essential for both mobility and stability. Dysfunctions in scapular motion or cervical alignment can disrupt scapulothoracic muscle coordination, potentially leading to stiffness and scapular dyskinesis, which in turn increases the risk for shoulder injury (12).

Given these considerations, this study seeks to fill a critical gap by identifying the most susceptible rotator cuff muscle among amateur boxers through a cross-sectional functional assessment. By employing validated clinical tools including the ASES questionnaire and targeted provocative tests such as the Drop Arm, Infraspinatus, Hornblower's, and Lift-off tests, this research aims to quantify the prevalence of rotator cuff dysfunction and determine which muscle is most commonly affected. A clearer understanding of these patterns can inform evidence-based strategies for prevention, early detection, and rehabilitation, ultimately contributing to improved shoulder health and athletic performance in the amateur boxing community.

Materials and Methods

This cross-sectional study was conducted over a period of six months and included a total of 184 amateur boxers from various university-level sports departments and UFC gyms located in Lahore, Pakistan. Participants were selected using a non-probability convenient sampling technique. The inclusion criteria comprised amateur male and female boxers aged between 18 and 30 years who had a minimum of two years of consistent boxing training or experience (13). Participants were excluded if they had a history of musculoskeletal degenerative diseases, any previous fractures or deformities involving the shoulder or arm, recent surgical interventions, or any known systemic

illness. These exclusion parameters ensured the evaluation of rotator cuff integrity in otherwise healthy individuals with consistent exposure to repetitive shoulder activity (14).

Rotator cuff tears are widely recognized as a significant risk in individuals engaging in repetitive overhead activities. Athletes, especially those subjected to repeated microtrauma such as tennis players and baseball pitchers, as well as individuals in professions requiring sustained overhead arm movement (e.g., painters and carpenters), are particularly vulnerable to these injuries (13). The assessment in this study involved the administration of the American Shoulder and Elbow Surgeons (ASES) Standardized Shoulder Assessment Form, a validated tool used to evaluate shoulder function and pain severity. In addition, specific physical examination tests were performed to identify signs of rotator cuff pathology.

The following special tests for rotator cuff muscles were employed during clinical assessment: the Drop Arm Test, with a reported sensitivity of 73% and specificity of 77%; Gerber's Lift-Off Test, with 50% sensitivity and 84% specificity; the Infraspinatus Test, which demonstrates 90% sensitivity and 74% specificity; and the Hornblower's Sign (Teres Minor Test), which shows 100% sensitivity and 62% specificity. These tests allowed for functional evaluation of individual rotator cuff components and aided in the identification of suspected muscle tears or dysfunction (15-18).

Ethical approval for the study was obtained from the institutional review board of the affiliated academic body, and all procedures were conducted in accordance with the

ethical standards. Written informed consent was obtained from all participants prior to their inclusion in the study. Data collected from the questionnaires and physical assessments were entered and analyzed using IBM Statistical Package for the Social Sciences (SPSS) software, version 25. Descriptive statistics were used to summarize participant demographics and frequency of positive test outcomes.

Results

A total of 184 amateur boxers were enrolled in the study, including 152 males (82.6%) and 32 females (17.4%), reflecting a higher male participation rate consistent with typical demographics in the sport. The participants had a mean age of 22.98 ± 3.51 years, indicating a young adult cohort actively involved in competitive boxing. The most frequently reported ages were 20 and 21 years, with each age group comprising 13.6% ($n = 25$) of the sample, suggesting a concentration of athletes in the early stages of their adult boxing careers. The study further revealed a notable prevalence of shoulder-related discomfort among participants. Approximately 50% of the boxers reported experiencing shoulder pain specifically during nighttime, which may indicate an underlying musculoskeletal imbalance or delayed onset of pain post-training or competition. In terms of pain severity, 52.2% of the participants classified their discomfort as moderate. Additionally, a substantial majority (81.5%) of the athletes indicated that they used painkillers as a primary method of pain management, highlighting a reliance on pharmacological relief rather than rehabilitative or preventive approaches.

Table 1: Demographic Characteristics of Amateur Boxers

Age (years)	Mean \pm SD
	22.98 \pm 3.51
Gender Frequency (%)	
Male	152 (82.6%)
Female	32 (17.4%)
Total	184 (100%)

Table 2: Descriptive Analysis of Special Tests Assessing Rotator Cuff Muscles in Amateur Boxers

Special Test	Rotator Cuff Muscle Assessed	Side	Positive Cases (n & %)	Combined Positive Cases (n & %)
Drop Arm Test	Supraspinatus	Right Arm	30 (16.8%)	72 (39.1%)
		Left Arm	42 (22.8%)	
Infraspinatus Test	Infraspinatus	Right Arm	42 (22.8%)	70 (38.0%)
		Left Arm	28 (15.2%)	
Horn Blower's Sign	Teres Minor	Right Arm	32 (17.4%)	48 (26.1%)
		Left Arm	16 (8.7%)	
Lift-Off Test (Gerber's Test)	Subscapularis	Right Arm	39 (21.2%)	68 (36.9%)
		Left Arm	29 (15.8%)	

Discussion

The present study investigated the incidence of rotator cuff injuries and associated shoulder dysfunction among amateur boxers, utilizing both special orthopedic tests and the ASES (American Shoulder and Elbow Surgeons) questionnaire to assess shoulder function and pain. The ASES tool, which evaluates pain and activities of daily living (ADLs), revealed that 50% of the boxers experienced night-time shoulder pain, while the remaining 50% reported no pain. Additionally, a significant majority (81.5%) of boxers reported using mild analgesics such as paracetamol for pain management. These findings were aligned with a previous study conducted by Christopher et al. (2021), which reported high self-medication rates among collegiate athletes in the U.S., with 70% of females and 61% of males consuming over-the-counter NSAIDs, and a concerning proportion also using alcohol to manage their pain (19).

Regarding pain severity, 22.8% of participants experienced mild pain, 52.2% reported moderate pain, and 25% suffered from severe pain, reflecting a considerable functional impact. These findings were consistent with the work of Valeria M.A. et al. (2017), who identified that 43.5% of athletes aged 15–19 reported shoulder pain that negatively affected their range of motion and daily functioning (20). Functional limitations were notably evident in ADLs; tasks such as putting on a coat, sleeping on the affected shoulder, washing the back, combing hair, and reaching for overhead shelves were all reported to be difficult by a large proportion of participants. For example, 60.3% of boxers found it somewhat difficult to put on a coat, while 23.4% reported it as very difficult and 6.0% were unable to perform the task. Similarly, lifting a 5 kg weight above shoulder level proved problematic for most, with only 5.4% reporting no difficulty, highlighting the widespread functional compromise.

The observed deficits in shoulder function were strongly associated with special test findings. Among the rotator cuff muscles evaluated, supraspinatus involvement was the most common, inferred primarily through positive Drop Arm Test results. Although 22.8% of participants tested positive in the left arm Drop Arm Test, the cumulative data across both shoulders suggested that approximately 39.1% of participants showed signs of supraspinatus pathology. This aligns with prior findings indicating high vulnerability of the supraspinatus to overuse and trauma in overhead and impact sports. The study by Andrew Watson et al. (2021) also emphasized the broader implications of such injuries, noting that 31% of young athletes experienced a decline in quality of life post-injury, including increased fatigue, reduced sleep quality, and difficulty performing everyday tasks (21, 22).

This study offered valuable insights by targeting a relatively understudied athletic group—amateur boxers—

where the incidence of rotator cuff pathology is often underrecognized. Strengths of the study included the use of standardized assessment tools, a relatively large sample size, and the dual focus on both pain and functional limitation. However, limitations included the reliance on self-reported data in the ASES questionnaire, which may be subject to response bias. Additionally, imaging modalities such as MRI or ultrasound were not employed to confirm the clinical diagnosis of rotator cuff injuries, potentially underestimating or overestimating true incidence. Furthermore, the cross-sectional design restricted the ability to infer causality or observe long-term progression. Future research should incorporate longitudinal designs and objective diagnostic tools to better understand the onset and progression of rotator cuff pathology in combat sports. Regular screening, rehabilitation, and training modifications may help reduce the burden of shoulder dysfunction in this population.

Conclusion

This study identified a high incidence of rotator cuff dysfunction among amateur boxers, with supraspinatus being the most commonly affected muscle, impacting up to one-third of participants and resulting in significant pain and functional limitations; these findings highlight the urgent need for early screening and preventive strategies in athletic training to preserve shoulder integrity and optimize long term musculoskeletal health.

Authors' Contributions

ICMJE authorship criteria	Detailed contributions	Authors
Substantial Contributions	Conception or Design of the work	1,2,3
	Data acquisition	3,4,5
	Data analysis or interpretation	2,4
Drafting or Reviewing	Draft the work	4
	Review critically	1,2,4,5
Final approval	Final approval of the version to be published.	1,2,3,4,5
Accountable	Agreement to be accountable for all aspects of the work.	1,2,3,4,5

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