Proceedings of the 6th International Conference on Biological Engineering and Medical Science
DOI: 10.54254/2753-8818/2026.38761

Shoulder Injuries in Swimming, Basketball and Strength Training: Mechanisms, Rehabilitation and Prevention

Bingyan Guo

Tsinghua International School Daoxiang Lake, Beijing, China
a2009840000@126.com

Abstract. The shoulder is the most mobile joint within the human body, yet its shallow bony socket makes it structurally vulnerable to sports-related injuries. This paper examines shoulder injuries across three representative sports: swimming, basketball and strength training. Swimming mainly produces chronic overuse injuries caused by millions of cyclic arm strokes, which place repeated stress on the rotator cuff tendons. Basketball creates mixed injury patterns combining cumulative overhead strain from shooting and blocking with acute traumatic damage from physical contact and falls. Strengthtraining-related shoulder harm arises from heavy external loading, flawed movement technique and poorly managed training volume. The paper compares injury mechanisms, athletic consequences, rehabilitation pathways and sport-specific preventive measures across the three sports. Common pathological conditions include rotator cuff damage, shoulder impingement and glenohumeral instability, and all three require careful, sport-adapted rehabilitation before an athlete can return to full training and competition. Generic rehabilitation and prevention advice cannot fit all athletic contexts. Targeted measures, such as correcting stroke technique, rebuilding shoulder stability and controlling training load, can effectively reduce injury incidence, support functional recovery and sustain long-term athletic performance.

Keywords: Shoulder injury, overuse injury, rotator cuff, sport rehabilitation, injury prevention

1. Introduction

The shoulder is the most flexible joint in the human body. It is what allows us to lift a suitcase over our head, throw a ball, reach the top shelf, or swim from one end of a pool to the other. Almost every movement that involves the arms passes through the shoulder. What makes it special is that, unlike the knee or the hip, the shoulder does not rely on deep bone sockets for stability. The upper arm bone sits in a fairly shallow cup, and the joint is mostly held together by a network of muscles, tendons and ligaments around it. This is a clever design because it gives the shoulder an enormous range of motion, but it is also the reason the shoulder is so easy to injure. When those soft tissues are weak, tight, or overloaded, the joint easily slips out of its normal position and problems start [1].

Shoulder injuries are extremely common in athletes. They bring pain, stiffness and loss of strength, and in serious cases they can force a player to stop training for months. Yet most general advice about shoulder injuries is written without much thought for the sport involved. A swimmer, a

© 2026 The Authors. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (https://creativecommons.org/licenses/by/4.0/).

DOI: 10.54254/2753-8818/2026.38761

basketball player and a weightlifter all use their shoulders differently, and the injuries they get are different too. What works as prevention for one may be useless for another, which is why the sport has to be part of the discussion rather than an afterthought. This essay looks at shoulder injuries in three sports: swimming, where the shoulder is subjected to thousands of repeated strokes; basketball, where overhead skills are combined with physical contact; and strength training, where heavy weights put direct mechanical stress on the joint. For each sport I discuss how the injuries happen, how they affect the athlete, how recovery is handled, and what can be done to prevent them.

2. Swimming

Swimming is a sport built on repetition. Every lap involves the same arm stroke performed hundreds of times, and over the course of a season a serious swimmer may perform millions of strokes. The shoulder bears almost all of this load. Studies have consistently found that around 90 percent of overuse injuries in swimmers occur in the shoulder, which is far more than any other part of the body [2]. Freestyle and butterfly are the worst offenders. In these strokes the arm is held in an awkward, stretched position while being pulled against the resistance of the water, so the rotator cuff tendons and the bursa get squeezed and rubbed over and over again. Many swimmers feel the first warning signs as a dull ache near the top of the shoulder that shows up only when they push hard, and then slowly starts to linger.

Swimmer's shoulder rarely appears suddenly. It builds up gradually. Each stroke causes a tiny amount of damage to the soft tissues, and normally the body repairs this damage overnight. The trouble starts when a swimmer trains more than the tissues can handle. The classic causes are easy to list. Some swimmers suddenly increase their training distance or the number of strokes they do, leaving no time for recovery. Others have poor technique: dropping the elbow or failing to roll the body properly pushes the humeral head into the wrong place and narrows the space under the acromion, which compresses the tendons [3]. Then there is the muscle imbalance that almost every competitive swimmer develops over time. Years of paddling make the internal rotators and the muscles that pull the arm inward strong and tight, while the external rotators and the muscles that stabilise the shoulder blade stay weak. This imbalance makes the shoulder less stable, and when the muscles get tired late in a training session, they lose the ability to hold the joint in place. The result is that the shoulder shifts and pinches soft tissue, which is exactly when the pain starts.

The effect on a swimmer is gradual but destructive. At first the pain only appears during hard efforts. Then it starts to bother them even in easy swimming, and finally it limits their stroke completely. Because pain makes swimmers change the way they move, their technique breaks down and they get slower. Many try to manage the problem by cutting back on training, which only makes their fitness and stroke quality worse. If nothing is done, the chronic irritation can develop into a partial tendon tear that may take a long time to heal [3].

Recovery for swimmers is mostly about restoring balance. Early on, the focus is on settling the inflammation, using physical therapy such as ultrasound and manual release of tight tissue. Once the pain eases, the real work begins: strengthening the weak external rotators and shoulder blade stabilisers, and stretching the tight chest muscles that pull the shoulder forward. This phase takes patience, because swimmers want to be back in the pool and often push the rehab faster than the shoulder can handle. Only when the shoulder is stable again should the swimmer start slow, low-intensity stroke practice to rebuild the correct movement pattern before returning to full training. Prevention follows the same logic. Coaches should check stroke technique regularly to catch problems like a dropped elbow or weak body roll. Training volume should increase gradually, with planned rest days. And swimmers need regular strength work for the stabilising muscles, plus

DOI: 10.54254/2753-8818/2026.38761

some cross-training, so the shoulder is not subjected to the same repetitive stress every single day [2].

3. Basketball

Basketball is different from swimming because the shoulder has to cope with two very different kinds of stress at the same time. On the one hand, players perform the same overhead movements thousands of times, shooting jump shots and blocking, which gradually wears down the tendons. On the other hand, the sport is full of collisions, falls and sudden changes of direction, which can cause acute injuries in an instant. So basketball players end up with both chronic overuse problems and traumatic injuries, often in the same career.

The most common chronic problem is wear and tear on the rotator cuff. Every time a player shoots or blocks, the shoulder is driven into an overhead position, and the tendons that stabilise the joint get rubbed against the bone. Over months and years this causes inflammation and, eventually, small tears. Shoulder impingement is closely related: when the space under the acromion is narrow, the tendons get pinched during overhead movement, which hurts and limits range of motion. The acute injuries are more dramatic. A hard collision or a bad fall, especially when a player lands on an outstretched arm, can dislocate the shoulder, pushing the head of the upper arm bone completely out of the socket [4]. This is extremely painful and brings swelling and a feeling that the joint is about to come out again. Falls and blows to the top of the shoulder can also sprain the AC joint, the small joint between the collarbone and the shoulder blade.

These injuries take a real toll on a player's game. Chronic shoulder ache makes it harder to shoot accurately, cuts down the reach for rebounds, and slows down defensive arm movement. Players quietly avoid the movements that hurt, which only makes their technique worse. A player might stop extending fully on a jump shot without even realising it, and over time that habit becomes permanent. An acute dislocation is even more serious: it stops training and games immediately, and the long break that follows lets fitness and skill decline. There is also a mental side that people do not always talk about. After an injury, players often become afraid to jump for a rebound or go in for a strong block, and that hesitation alone can hurt their performance [5].

Rehabilitation for basketball players has to rebuild both stability and explosive power. Right after an acute injury, the priority is to reduce swelling and protect the damaged ligaments so nothing gets worse. Once the acute phase passes, the athlete strengthens the shoulder and the upper back to give the joint stability again. The last stage is sport-specific: overhead throwing, jump shots and controlled practice against contact, so the shoulder learns to cope with both the repeated shooting motion and the sudden impacts of a real game. Prevention comes from a mix of strength training, better technique and awareness on the court. Players need balanced strength in the shoulder and back to absorb impact. Coaches should correct poor overhead habits before they become injuries. And players should learn how to fall safely and avoid taking hard hits to the shoulder. Simple things like warming up properly before practice and stretching afterwards also help a lot over a long season.

4. Strength training

Strength training is built around controlled external load. Exercises like the bench press, overhead press, pull-ups, rows and deadlifts all push or pull heavy weight through the shoulder, and that weight is far more than the body would normally feel in daily life [6]. The shoulder injuries that come from lifting are load-related. They happen when heavy weight is combined with poor movement technique and a training plan that does not allow enough recovery [7].

DOI: 10.54254/2753-8818/2026.38761

The most common lifting injuries are rotator cuff tears, shoulder impingement and biceps tendonitis [8]. A lot of these start with the position people put their shoulders in. When a lifter tries to bench press or overhead press a weight that is slightly too heavy, the body finds a way to cheat, often by rounding the shoulders and rotating the arm inward. This squeezes the rotator cuff tendons and the bursa between the humerus and the acromion. The more this happens, the more inflamed the tissue becomes, and in severe cases it can degenerate or tear [9]. Pulling movements create their own problem: pull-ups and rows overwork the biceps tendon at the front of the shoulder, which becomes inflamed and causes a dull ache that may travel down the arm.

A big part of the problem is how people train. Many lifters want to add weight quickly and pack several heavy shoulder exercises into a single week without enough rest between sessions. The micro-tears in the tendons never get a chance to heal fully, so the tissue grows weaker over time. Unbalanced training is another factor. When the chest and front of the shoulder are overdeveloped while the back is weak, the shoulder is pulled forward out of its natural position, which puts more pressure on the tendons whenever a weight is lifted.

The effect on a lifter is straightforward: pain limits how much weight they can handle. Minor injuries cause a nagging ache during pressing and pulling, which reduces strength and slows progress. More serious damage makes overhead movements difficult or even impossible, and can interfere with everyday tasks like reaching up or carrying a bag. A lot of lifters shrug off the early ache and keep training through it, telling themselves it is just muscle soreness, and that is often exactly how a small irritation turns into a tear that keeps them out of the gym for months. Ignoring load-related shoulder pain for too long can turn a small problem into a chronic condition that takes months to resolve.

Recovery from a lifting injury starts by taking the load off. The lifter stops heavy lifts and lets the inflammation settle with rest and physical therapy. Then they practise light movements to relearn a neutral, safe shoulder position. Resistance bands and light dumbbells are useful here, because they rebuild the rotator cuff and scapular control without loading the joint heavily. Only when the shoulder is stable again should the lifter slowly reintroduce the compound lifts. Prevention is mostly about discipline. Lifters should increase weight gradually instead of chasing new records, and make sure their training plan has enough rest. Regular mobility work for the shoulder and targeted rotator cuff strengthening keep the joint healthy and stop problems before they develop.

5. Common shoulder injuries and return-to-sport criteria

Although the three sports damage the shoulder in different ways, the injuries they produce often look the same. Rotator cuff problems, shoulder impingement and instability show up in all three, just for different reasons. The rotator cuff, the group of muscles and tendons that hold the shoulder together, is the most vulnerable part [10]. Swimming wears it down through repetition, basketball through a combination of overhead movement and impact, and strength training through the compression of heavy loads. Impingement happens when the space under the acromion becomes too small and squeezes the soft tissue; the cause might be muscle imbalance in a swimmer, tired movement in a basketball player, or bad posture in a lifter. Instability can be as mild as a chronic looseness from weak muscles, or as severe as a full dislocation after a sudden injury [11, 12].

Whatever the sport, the rules for returning to play after a shoulder injury are the same. The athlete needs full, pain-free movement in all directions first, without tenderness when performing the movements their sport requires. Then the shoulder has to be strong enough: strength, endurance and stability should be back to pre-injury levels, and the difference between the left and right sides should be small. Finally, the athlete needs to feel mentally ready, confident that the shoulder will

DOI: 10.54254/2753-8818/2026.38761

hold up, because fear of re-injury is a real risk on its own. In practice, this often means building up gradually, starting with light sport-specific drills rather than jumping straight back into full competition. Only when all these conditions are met should the athlete return to full training and competition [13].

6. Conclusion

The three sports in this essay put completely different demands on the shoulder, and that shows up in the injuries they cause. Swimming is dominated by chronic overuse: thousands of repeated strokes, muscle imbalance and fatigue gradually wear down the shoulder. Basketball combines gradual strain from overhead skills with sudden traumatic injuries from falls and contact. Strength training injuries come from external load, poor technique and too much volume working together to damage the soft tissues mechanically.

Even though rotator cuff problems, impingement and instability appear in all three sports, the way to prevent and treat them is different. Swimmers need to fix muscle imbalance and refine their stroke. Basketball players need to build joint stability and learn to handle impact. Lifters need to focus on clean movement and controlled load increases. The point is that there is no single recipe for shoulder health. A general list of stretches handed out to every injured athlete misses the real problem, because the problem is different in each sport. Sport-specific prevention and rehabilitation can cut injury rates, speed up recovery and help athletes keep performing for longer. Future research could collect more numbers on the risk factors involved, so that coaches can design more personal injury-prevention and recovery plans for their athletes.

References

[1] Shoulder pain explained. Swimmer's shoulder: Causes, treatment and prevention [Internet]. [cited 2026 Sep 22]. Available from: https://www.shoulder-pain-explained.com/swimmers.htmlh

[2] Wanivenhaus, F., Fox, A. J., Chaudhury, S., & Rodeo, S. A. (2012). Epidemiology of injuries and prevention strategies in competitive swimmers. *Sports Health, 4*(3), 246–251. https://doi.org/10.1177/1941738112442132

[3] Sein, M. L., Walton, J., Linklater, J., Appleyard, R., Kirkbride, B., Kuah, D., & Murrell, G. A. (2010). Shoulder pain in elite swimmers: Primarily due to swim-volume-induced supraspinatus tendinopathy. *British Journal of Sports Medicine, 44*(2), 105–113. https://doi.org/10.1136/bjsm.2008.047282

[4] Robinson, T. W., Hensley, C., & Waterman, B. R. (2020). Return-to-sport outcomes after first-time anterior glenohumeral dislocation in young athletes. *Orthop J Sports Med, 8*(6), 2325967120922203. https://doi.org/10.1177/2325967120922203

[5] Basketball injury. Shoulder injuries - basketball injury [Internet]. [cited 2026 Sep 22]. Available from: https://basketballinjury.com/shoulder-injuries/

[6] StrengthLog. The four basic movements of strength training [Internet]. [cited 2026 Sep 22]. Available from: https://www.strengthlog.com/four-basic-movements/

[7] Lombardi, I., Jr, Magri, A. G., Fleury, A. M., Da Silva, A. C., & Natour, J. (2008). Progressive resistance training in patients with shoulder impingement syndrome: A randomized controlled trial. *Arthritis and Rheumatism, 59*(5), 615–622. https://doi.org/10.1002/art.23576

[8] Ortho Surgery. Common shoulder injuries from lifting [Internet]. [cited 2026 Sep 22]. Available from: https://www.kneeandshouldersurgery.com/common-shoulder-injuries-from-lifting/

[9] Varacallo, M., El Bitar, Y., & Mair, S. D. Rotator cuff tendonitis. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 [cited 2026 Sep 22]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK470589/

[10] Verywell Health. Rotator cuff pain: Treatment, symptoms, causes [Internet]. [cited 2026 Sep 22]. Available from: https://www.verywellhealth.com/signs-and-symptoms-of-rotator-cuff-pain-5119043

[11] Harvard Health. (n.d.). How to treat shoulder impingement [Internet]. [cited 2026 Sep 22]. Available from: https://www.health.harvard.edu/bones-and-joints/how-to-treat-shoulder-impingement

DOI: 10.54254/2753-8818/2026.38761

[12] Shoulder & Elbow Society. (n.d.). Shoulder dislocation and instability: Time, mechanism and direction [Internet]. [cited 2026 Sep 22]. Available from: https://www.shoulderdirect.net/shoulder-conditions/shoulder-instability/shoulder-dislocation/

[13] Griffith, R., Fretes, N., Bolia, I. K., Murray, I. R., Meyer, J., Weber, A. E., Gamradt, S. C., & Petrigliano, F. A. (2021). Return-to-sport criteria after upper extremity surgery in athletes-a scoping review, part 1: Rotator cuff and shoulder stabilization procedures. *Orthopaedic Journal of Sports Medicine, 9*(8), 23259671211021827. https://doi.org/10.1177/23259671211021827