

THE PERILS OF HANDBALL SHOULDER PHYSIOTHERAPY

– *Written by Rod Whiteley, Qatar*

WHAT DO YOU GET WHEN YOU CROSS RUGBY LEAGUE, WATER POLO & BASEBALL?

Prior to starting work at Aspetar – Orthopaedic and Sports Medicine Hospital, I was, at best, only vaguely familiar with handball. I watched it live at the 2000 Sydney Olympic Games where it interested me, but afterwards I found that I was unable to see much more given the poor exposure the game gets in Australia. Besides this, there was no time for me to get involved in another sport since my working life was spent with the rugby codes (rugby union and rugby league) in winter and with baseball in the summer. The last few years living in Qatar have only served to increase my appetite for handball as I have had more exposure to it, and I've learnt that spending the past 20 years working with athletes involved in collision and throwing sports has been good

preparation for handball physiotherapy. Coming to handball from this background was a start, but I would have preferred to be more solidly grounded in the literature. It was surprising to me to find that there is relatively little written in English on injury to handball players' shoulders. What follows is unashamedly drawn from my personal experience, along with the knowledge I have gleaned from my colleagues who have spent much more time with these athletes, and a significant amount of extrapolation from the literature in other areas. This paper will talk only about shoulder injury in handball players and, since it is my experience, only in males. I have deliberately chosen to focus on this area as I feel that this has been under-represented in the literature (in comparison to knee and elbow injury) and represents a significant injury burden for these athletes.

My main aim is to provide some 'short-cuts' for the clinician working in this area in terms of assessment and management of their athletes. Necessarily, this involves some simplification of the spectrum of presenting pathologies. This is not to imply that these are the only pathologies seen in handball, these are simply the ones which form the majority of my experience. This similarly does not discount the very real possibility that there are other pathologies that I have not seen (but that have seen me). I hope that the amount of times I am forced to rely on this personal experience and extrapolation from the literature will annoy readers who work in this area enough to drive them to formally document what they are doing, and help provide more science to back up the care they provide.



RUGBY AND HANDBALL: SAME BUT DIFFERENT

Two of the most striking similarities I have found between handball and rugby players have been physical and psychological.

Physical similarities

Firstly, physically speaking, handball players are bodily imposing and significantly 'bigger' than Aspetar's other large category

of athletes, football (soccer) players. Our demographic data from routine pre-season screening suggests that the average player is at least 20 kg heavier and 10 cm taller than our average football players. This presents some problems in strength testing and weight room injury for these athletes that I will discuss later.

Psychological similarities

The second similarity involves psychology. When working with rugby, I was often asked by friends who were fans of the teams I looked after, "How are the team looking? Are they all fit and ready to go this week?" I would always tactfully avoid answering this question as the real answer was that I can hardly ever recall a single rugby player who was truly 100% injury-free during the season. It is simply the nature of a collision sport that all players will likely be 'carrying' at the very least some minor bump or scrape. Often, though, players would be carrying such a significant injury that I had trouble believing someone could possibly run with, let alone perform all other aspects of their game at the highest level.

In this regard, I think the culture of handball seems to be similar. Players crash into each other and expect to do so during both practice and games. After playing handball for a while, all these athletes expect to be beaten up to a greater or lesser extent most of the time. The practical upshot of this is that our efforts to monitor injury based on time-loss definitions wildly underestimate the burden carried by a team at any one time. In this regard, we at Aspetar are working towards using what we feel is a more appropriate measure – that of 'level of participation' – which more accurately reflects what injury is doing to players who are competing, but perhaps not at their maximum due to injury¹. The added benefit here is that this information is more likely to be useful for the coaching staff who can quantify the effect of players who are carrying an injury. Similarly, when returning from an injury to an environment where physical confrontation is mandatory, late stage rehabilitation is as much about preparing the athlete physically (i.e. ensuring the injury has adequately healed and been rehabilitated) as well as ensuring

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that psychologically, the athlete is ready for the rigors of the game which are never fully replicated in a rehabilitation setting. These latter requirements are athlete-specific and acknowledging these differences and then including them in your rehabilitation is an extremely important facet^{2,3}.

ASSESSMENT OF THE HANDBALL PLAYER'S SHOULDER INJURY

As always, clinical examination begins with an appropriate targeted questioning of the athlete. For a handball player, it is especially important to establish the circumstances surrounding their main complaint. Typically this will be related to throwing, collision or weight-training. In my experience, each of these different histories will result in different injury patterns.

Throwing related

A player who presents with a 'pure' throwing-related injury will typically describe one of two patterns of pain depending on which stage of the throw their injury occurs.

1. Deceleration phase

The simplest, and least common, is the thrower who describes pain after releasing

the ball during a hard throw, and will tell you that his pain is localised to his posterior shoulder. He will also tell you that the intensity of pain increases with the velocity of throwing, and likely this has been progressively worsening over a period of time. Often these players don't present until their symptoms are quite advanced as this pain doesn't reduce their throwing effectiveness, it simply hurts *after* every throw. The culture of handball seems to be to simply grin and bear it – one of our jobs working with these guys is to try to get to these problems earlier when they are easier to fix.

On examination you may see some wasting in the infraspinous fossa, but will almost always find pain on resisted external rotation, as well as a likely reduction in 'true' internal rotation range of motion^{4,5} (see Table 1 below for explanation of examining rotational range of motion, factoring in humeral torsion and setting 'true' rotational range of motion goals for stretching).

I suspect that the source of pain here is eccentric overload of the posterior cuff, deceleratory muscles. Management is uncomplicated if the playing and training demands of the player allow compliance to rehabilitation. The resilience of this

posterior cuff needs to be improved, along with any associated scapular dyskinesia that you can tie to the problem (best done through a scapular assistance test⁶ while performing resisted external rotation). To get an idea of how long the player is going to have to work on this, it's important to measure his rotational strength. We have now collected a small amount of normative data which compares similarly with that seen in baseball players⁷ (Figure 1). From this it would appear that our previously documented norms for rotational strength ratios hold, and the cut-off point of 1.5 for the ratio of internal to external rotation delineating injured from uninjured shoulders also holds. A word of caution in strength testing these players: you will encounter players who are over 100 kg, some generously so. It is our experience that the more skilled players will have an internal rotation strength in their throwing arm of approximately 30% of their bodyweight, but we have recorded a maximum of 50%, so ensure good body position and technique when doing this testing otherwise the test becomes a measure of your strength rather than the player's. A staged and graded return to throwing is always an important part of a thrower's rehabilitation (Table 2)⁸.

TABLE 1

<i>Measure TROM (IR + ER)</i>	<i>Is the TROM equal \pm 5° for dominant and non-dominant arms?</i>	<i>Yes</i>	<i>No further assessment needed</i>
		<i>No</i>	<i>Measure humeral torsion bilaterally</i>

Is there a side-to-side difference in humeral torsion?

No *No further assessment needed: rotational range targets are the same for injured and uninjured arm*

<i>Yes</i>	<i>Injured arm more retrotorsion</i>	<i>External rotation target increased by this amount</i>	<i>Internal rotation target decreased by this amount</i>
	<i>Injured arm less retrotorsion</i>	<i>External rotation target decreased by this amount</i>	<i>Internal rotation target increased by this amount</i>

Table 1: Algorithm for setting rotational range of motion targets in throwing athletes. Clinically, differences of less than 5° are likely trivial, 10° warrant attention and 20° are significant. TROM=total rotational range of motion, IR=internal rotation, ER=external rotation.

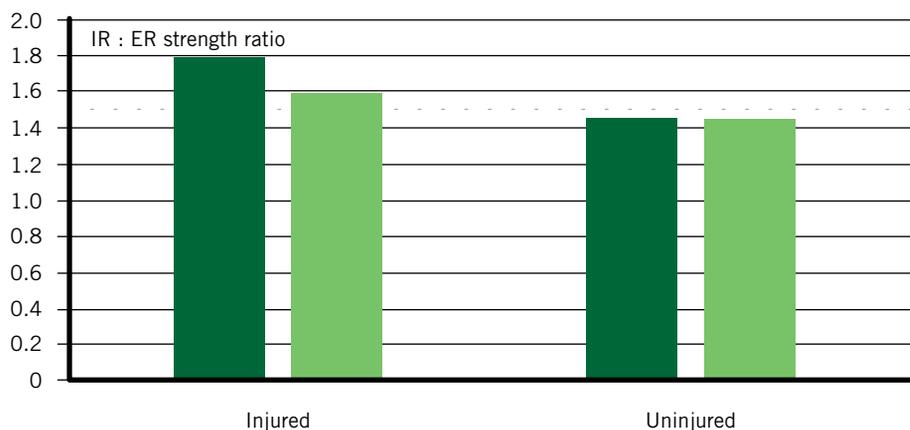
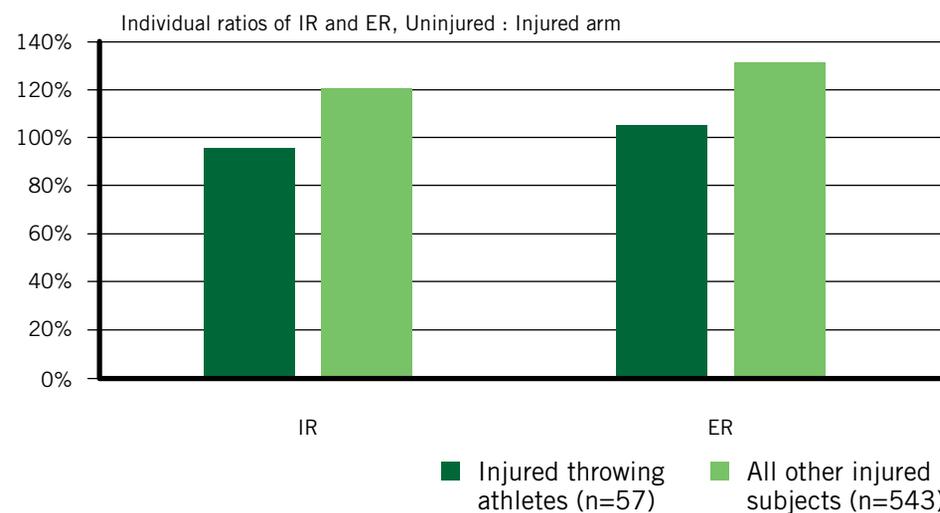
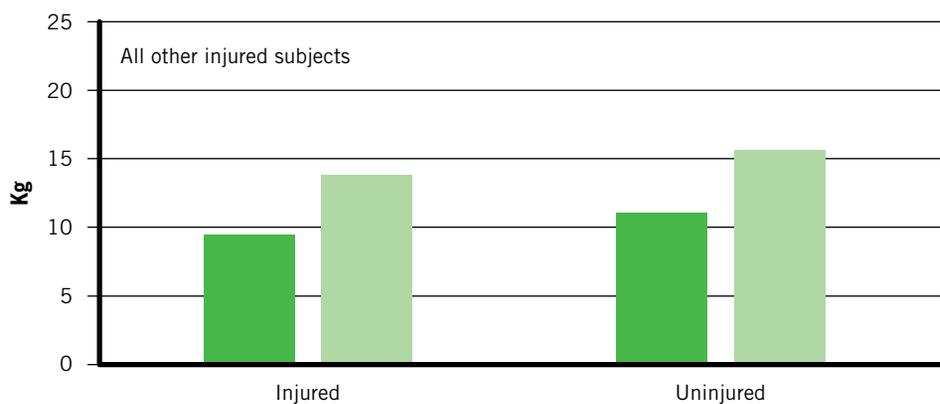
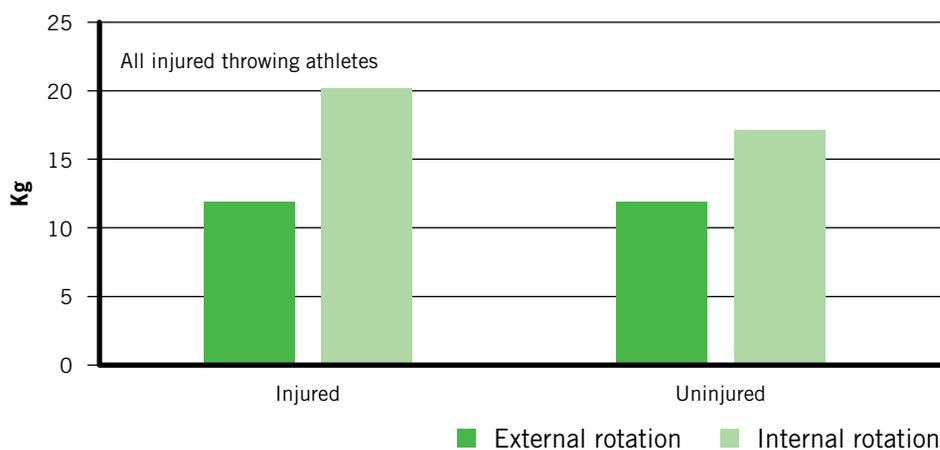


Figure 1: Hand held dynamometry scores for a consecutive clinical series of 600 patients with unilateral shoulder pain. “Entire Cohort IR:ER” refers to the average of all subjects IR compared with the average of all subjects ER. “Individual Uninjured:Injured” refers to the individual subjects’ measures of their injured arm compared with their uninjured arm. ER indicates external rotation; IR, internal rotation

Since the load on the deceleratory muscles is directly proportional to how hard the player is throwing, it’s important that we increase this load carefully, with throwing velocity as the intensity trigger. Ideally, you would use a radar gun to ensure that they are carefully stepping up, but this is rarely practical so a distance-based return to throwing works better. The handball player will ultimately need to make approximately 100 throws during practice, of which up to 50 will be at maximum velocity. Rehabilitation then needs to have a similar goal before we can permit safe return to practice. Typically, we work with a player commencing throwing over a short distance of 5 to 10 m, and throwing in such a way that the ball ‘just’ carries this distance.

The aims of the throwing programme are initially to simply build the volume of throws (over a short distance) to 100, then once this volume of throwing is tolerated, to add higher intensity throws into this session, with the initial throws serving as a warm-up. If there are any issues regarding faulty throwing mechanics, these early stages are a good time to address these, when the thrower is making low intensity throws. To commence the player will only make 20 to 40 short throws, ultimately building this up to 5 sets of 20 as symptoms and throwing ability allow. Once this volume is safe, we can increase the intensity by increasing the distance of some of these throws. Moving out by approximately 5 m steps seems to be tolerated, although handball coaches will prefer shorter distances, and shorter progressions as players rarely (if ever) throw longer than 10 m in a game. It’s important to explain to the player (and coach) that we are controlling for throwing velocity by increasing the distances, and later the throws will be shorter (but harder) to mimic the sport’s demands.

Typically we just increase one of these sets by 5 m per session, however your ultimate aim is to have the player completing 2 to 3 sets of 20 throws at or near their maximum. I prefer to ask the player to complete each stage twice, with no exacerbation of symptoms which earns them the right to move up one stage. If symptoms return, we can then safely return to the most recently safely completed stage, pretty safe in the knowledge that it will be tolerated. As the throwing intensity increases, you will likely get to a stage where the player can rejoin practice, under the instructions to not throw harder than they have safely achieved during their graded throwing programme.

Importantly, the thrower must be maintaining good accuracy/precision during these throws. He should not be 'missing' his target by more than a metre or so, even at the extremes of distance. Clinically, I suspect that if players start to lose accuracy during a session, this indicates the onset of fatigue and the thrower probably needs to stop before an aggravation occurs. It's important to explain this to the thrower, and to encourage such attention to accuracy during these and all subsequent throwing bouts.

This type of throwing problem is almost entirely due to the speed of the arm during

the throw. Once a safe return to sport has occurred, the player should continue some form of preventive strengthening I suggest occasional underweighted throwing which will allow higher velocity of throwing and therefore greater stress on the deceleratory musculature.

2. Acceleration phase

More challenging is the thrower with the spectrum of 'inside impingement' injury^{9,10}. Here the thrower will likely present with:

- a painful reduction in throwing velocity,
- pain during the cocking phase of throwing that is typically sharp, localised anteriorly on what seems to be near the long head of biceps origin,
- perhaps with a 'click/catch' 'inside' their shoulder and
- possibly a localised postero-superior shoulder pain.

This spectrum of injury seems to be a superior labral injury associated with an undersurface postero-superior cuff tendinopathy that we suspect is compressive in nature (as the postero-superior cuff folds into the joint during the cocking phase). This more serious injury will definitely affect a thrower's shooting velocity and therefore his ability to compete at his desired level.

We suspect that the earlier in the disease process this is caught, the better chance you have of a successful rehabilitation, however prognosis for a complete recovery in a player who has a significantly reduced throwing velocity associated with higher levels of pain is guarded. Conservative rehabilitation is aimed at restoring rotational ranges of motion along with cuff strength and scapular positioning, followed by a graded return to throwing (Table 2). Players who fail this management may proceed to surgical care, however again the prognosis for return to desired level of play remains guarded, and this is a problem best prevented rather than treated.

During throwing-type exercises in rehabilitation, the thrower will benefit from careful overweight-type throwing (medicine-ball) which has a higher force but lower velocity, and higher load on the shoulder in preparation for return to throwing. If successful return to throwing is achieved, this will form an important part of his maintenance programme, along with an appropriate weights programme.

Blocking

The next category of injury seen in the handball player's shoulder arises due to a blocked shot. In handball, the defence

TABLE 2

Stage	Distance (m)	Throws								
1	5	20	10	20						
2	5	20	5	20	5	20				
3	5	20	10	20	5	20	10	20	5	20
4	5	20	10	20	15	20	10	20		
5	5	20	10	20	15	20	20	20	10	20
6	5	20	10	20	15	20	20	20	20	20
7	5	20	10	20	15	20	20	20	25	20
8	5	20	10	20	15	20	25	20	25	20
9	10	20	15	20	20	20	25	20	25	20

Table 2: Example of a staged graded interval throwing programme. Ultimately the player is making 100 throws, of which 40 are close to maximum effort. Ideally the player would be completing this throwing programme 2 days out of 3, and needs to complete each stage twice before being allowed to move on. If symptoms are worsened, the player needs to move back a stage. This can be started very early in the rehabilitation as the lower speed (hence intensity) throws place low loads on the shoulder, especially the deceleratory musculature.



In handball, the defence attempts to interrupt a shot on goal, by fair means or foul.



attempts to interrupt a shot on goal, by fair means or foul. This will result in unexpected loads being placed on the thrower's arm at varying stages of the shot. Injuries typically occur when these blocks happen during the cocking and acceleration phases.

Cocking phase blocked shot

I suspect that an unexpected block during cocking phase most likely forces excessive passive shoulder horizontal abduction. Confirmation of this mechanism during your assessment will be if the athlete's pain is reproduced with passive horizontal abduction in neutral or slight (<50°) external rotation. Typically, after identification of the structure at fault and appropriate rehabilitation, these will cure well.

Acceleration phase blocked shot

More difficult is when the block occurs during the acceleration phase. I suspect that the forces are higher, and the superimposed action of pectoralis major and latissimus dorsi while the arm is abducted and externally rotated likely make a traumatic anterior instability higher on the list of likely pathology. If this is the case, the player will probably tell you that he had a sensation of his shoulder "coming out". It's important that you examine for any neurological deficit if anterior instability is present. Loss of deltoid function (due to trauma to the circumflex humeral/axillary nerve) will cause significant shoulder dysfunction. Similarly but more complex is any neurological dysfunction caused by brachial plexus traction during the blocking manoeuvre or occasionally by direct blows. A careful screening neurological examination followed up by examination by an appropriate medical practitioner is essential in documenting any deficit to be

able to track the recovery and plan for safely staged rehabilitation as neural function returns. Management of anterior instability in handball players is complicated by the need to maintain external rotation range of motion to be able to throw with maximum velocity. If an anterior instability ends up requiring surgical management (due to the nature of the sport), the surgeons we work with often prefer a Latarjet procedure which will result in a significant loss of external rotation range of motion. It is likely that this will be problematic for a player whose game is significantly based on having a strong shot as this will rarely be present after the surgery. In our experience though, the Latarjet procedure provides a more definitive solution to problematic recurrent anterior instability.

Collision and falls

Handball players don't have the luxury of falling on grass, nor of wearing any protective shoulder padding. Collisions with the wooden floor during falls on the point of the shoulder more often cause acromioclavicular joint injury than I had previously seen in rugby. Similar to rugby however, these players will typically return to play relatively quickly with symptomatic management unless their injury is associated with significant displacement and therefore likely rupture of the conoid and trapezoid ligaments. Management of these Tossy type III injuries is more difficult and it is best to get the opinion of an experienced surgeon.

Unfortunately, the long-term results of reconstructive surgery in these players is not encouraging. Persistent problematic acromioclavicular joint problems can have symptom resolution with excision of the outer end of the clavicle, however the long-

term consequences of this are not well-documented. If the experience of rugby is replicated in handball, I expect a significant portion of retired players suffer ongoing symptoms from their previously injured acromioclavicular joints¹¹.

Rehabilitation and return to sport of these injuries is assisted by game-specific falling practice. Players often include falling drills as part of their warm-up so will likely be familiar with this. Initially in rehabilitation this is done on more forgiving surfaces of soft mats and in a controlled, premeditated manner, but ultimately needs to be done on the hard floor, ad hoc etc. This can be an important psychological barrier to cross for the injured player who plans to return to competition, and needs to be adequately addressed lest he unwittingly tries to protect his shoulder and fall awkwardly, perhaps injuring another structure more seriously.

Weight room injury

Similar to rugby, an imposing physical presence is important for success in handball, where the outcomes of collisions help determine the score line. In the last few decades this has seen increasing time spent in the gym as part of regular training for these players. Up until perhaps the late 1960s, the prevailing culture in professional sports was that weight training made an athlete 'slow and muscle-bound'. Initially this myth was quashed in American football, and subsequently taken up by other sports internationally so that regular weight training is now the norm rather than the exception in professional sports. As the 'fad' of weights took hold in the 1970s, the only experts to turn to for advice were body builders who had over 60 years of experience in designing weights programmes. Unfortunately for

our athletes, the aim of these programmes was completely aesthetic: bodybuilders lifted weights unashamedly so that they looked 'good' in a mirror; for the upper body this meant a significant bias toward exercises for the pectorals, biceps, triceps, deltoid and latissimus dorsi. Little if any attention was paid to the posterior cuff and scapular stabilising muscles as these are difficult to see in a mirror. Accordingly, for a handball player presenting with shoulder pain relating to their weights programme, your first task should be to *thoroughly* document their weight training routine of exercises including sets, repetitions and normal weights. I often hear an athlete tell me they do a "good, balanced programme" comprising: "bench press, incline press, decline press, push-ups, dumbbell flies, biceps curls, ... oh and some rowing for my back ... but I don't do much rowing really." Such a bias in weight programmes (toward the anterior musculature of the chest and arms) is difficult to turn around culturally as it seems deeply engrained in the sport.

Typically, these problems are readily addressed with an alteration to the weights programme and some attention to the technique of the exercises being performed. However this can be difficult to enforce within the culture of the sport where players in part measure themselves by asking each other "how much can you bench press?"

In rugby we have previously had some success by enforcing a weight room rule that no-one was allowed to bench press any more than they could bench 'pull'. If a player wanted to increase the weight on their bench press, they first had to get permission from the strength and conditioning coach by demonstrating that they could bench pull the same weight for the planned number of repetitions. This essentially caused the players to all increase the amount of posterior shoulder and trunk work they did so that they would be allowed to do more bench pressing in their routine, but the net effect of a less imbalanced routine was achieved along with a reduction in these types of injury.

During your assessment, you will might find an elevated IR:ER ratio (internal rotation: external rotation) due to increased internal rotation strength. If the athlete is performing significant amounts of 'push' type exercises (bench press, push-ups etc),

you should especially ensure a careful assessment of the acromioclavicular joint is performed as osteolysis of the outer end of the clavicle can be easily missed and cause significant ongoing disability.

Where possible, weekly or at least fortnightly monitor the players' internal and external rotation strength (using hand held dynamometry). Previously I have had good experience using this to appropriately alter the subsequent week's weight programme according to these findings and found it extremely useful for reducing shoulder injury in a cohort of elite level water polo players over 1 year.

SUMMARY

For me, there is still much to be learned in the assessment and management of the injured handball player's shoulder, and the injury burden in this sport is significant and under-reported. Clinically, it has proven worthwhile to examine shoulder injury in the handball player according to the mechanism of injury: throwing related, blocking-related, collision-related, or from the weights room. As always, management is dictated by appropriate clinical reasoning, which in this case must include attention to the peculiar demands of this sport. Thankfully, the combination of athleticism, skill and physicality in handball means that it is a pleasant sport to watch and learn from and over the next few decades, I invite you to join me for the ride.

References

1. Clarsen B, Myklebust G, Bahr R. Development and validation of a new method for the registration of overuse injuries in sports injury epidemiology: the Oslo Sports Trauma Research Centre (OSTRC) overuse injury questionnaire. *Br J Sports Med* 2013; 47:495-502.
2. Ardern CL, Taylor NF, Feller JA, Whitehead TS, Webster KE. Psychological responses matter in returning to preinjury level of sport after anterior cruciate ligament reconstruction surgery. *Am J Sports Med* 2013; 41:1549-1558.
3. Podlog L, Dimmock J, Miller J. A review of return to sport concerns following injury rehabilitation: practitioner strategies for enhancing recovery outcomes. *Phys Ther Sport* 2011; 12:36-42.
4. Whiteley R, Ginn K, Nicholson L, Adams R et al. Indirect ultrasound measurement of humeral torsion in adolescent baseball players and non-athletic adults: reliability and significance. *J Sci Med Sport* 2006; 9:310-318.
5. Whiteley RJ, Ginn KA, Nicholson LL, Adams RD. Sports participation and humeral torsion. *J Orthop Sports Phys Ther* 2009; 39:256-263.
6. Kibler WB, McMullen J. Scapular dyskinesis and its relation to shoulder pain. *J Am Acad Orthop Surg* 2003; 11:142-151.
7. Whiteley R, Ocegüera MV, Valencia EB, et al. Adaptations at the shoulder of the throwing athlete and implications for the clinician. *Techniques in Shoulder & Elbow Surgery* 2012; 13:36.
8. Axe MJ, Windley TC, Snyder-Mackler L. Data-based interval throwing programs for collegiate softball players. *J Athl Train* 2002; 37:194-203.
9. Walch G, Liotard JP, Boileau P, Noel E. [Postero-superior glenoid impingement. Another shoulder impingement]. *Rev Chir Orthop Reparatrice Appar Mot* 1991; 77:571-574.
10. Burkhart SS, Morgan CD, Kibler WB. The disabled throwing shoulder: spectrum of pathology part I: Pathoanatomy and biomechanics. *Arthroscopy* 2003; 19:404-420.
11. Mouhsine E, Garofalo R, Crevoisier X, Farron A. Grade I and II acromioclavicular dislocations: results of conservative treatment. *J Shoulder Elbow Surg* 2003; 12:599-602.

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