SCREENING FOR TEAM HANDBALL

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HANDBALL BACKGROUND

Records show that games similar to handball have been around since early times, with the ancient Greeks playing a game called urania and the Roman equivalent being called harpaston. In the Middle Ages there are reports of similar games being played in France as well as by the Inuit in Greenland. The rules for the game of team handball, as we know it today, were written in the late 1800s in northern Europe, where the game was most popular in Sweden, Denmark, Norway and Germany.

The game is governed by the International Handball Federation (IHF), founded in 1946 and team handball was introduced into the Summer Olympics in 1972. The IHF currently has around 170 members with 795,000 teams and an estimated 25 million players worldwide.

Handball is a fast-paced game with full body contact, however illegal contact frequently occurs in other situations and results in a fall.

In addition to frequent body contact, other features of the way the game is played are associated with a risk of injury. For example, handball players are also prone to overuse injuries of the dominant upper arm due to the high volume of throws performed in training and matches.

A well-developed screening programme not only addresses the issue of intrinsic risk factors for injuries (particularly overuse injuries) but also the risk for sudden cardiac death and other illnesses which may affect a player’s health and performance.

WHAT IS SCREENING AND WHY SCREEN HANDBALLERS?

Screening, in medical terms, is defined as “a strategy used in a population to identify an unrecognised disease in individuals without signs or symptoms”. The World Health Organization published guidelines on the requirements for an optimal screening programme in 1968 that later became known as the Wilson-Jungner criteria.

Most screening tools used in athletes do not meet the Wilson-Jungner criteria since the medical conditions being sought are not an important public health problem. However, for a high level sportsperson, any medical condition that prevents them from playing, even for a short period of time, can be very significant to themselves or their employer, particularly in the case of a key player in an important match or final.

Screening medical assessments of players involved in team sports are traditionally performed in the pre-season period and/or at the conclusion of the season, before players depart for their holidays. Many different names have been given to these examinations such as periodic health examinations (PHE), pre-participation examinations (PPE) and pre-competition medical assessments (PCMA). There are several goals of these assessments:

• Review of injuries sustained in the previous season to check recovery status and whether any ongoing
rehabilitation is required (for example ankle proprioception and strengthening exercises after an ankle sprain may be required even after a player has returned to sport).

- Check compliance with any long-term rehabilitation exercises, for example a maintenance rotator cuff strengthening in someone with a previous history of shoulder pain.
- Review of hitherto unreported injuries or symptoms to enable the initiation of an appropriate rehabilitation programme.
- Review and optimisation of treatment of chronic medical conditions, such as the control of exercise induced asthma.
- Review of any other medical issues related to the sport such as nutrition, sleep and recovery patterns, psychological issues and medications which might require a WADA TUE (World Anti-Doping Agency Therapeutic Use Exemption) notification.
- Cardiac screening, investigating risk factors for sudden cardiac death.

To avoid confusion, it may be better to name these medicals ‘Periodic Health Examinations’ rather than ‘screening’ medicals.

However, one of the holy grails of screening is being able to prevent future injuries or illnesses by identifying those at risk during screening and then addressing these risk factors before any injury can occur. Using the van Mechelen model, that is frequently cited in sports medicine injury prevention literature, the first step in this process is to describe the significant injuries or illnesses that are likely to affect that particular sport. Once these have been described, risk factors for these injuries should be identified so that strategies can be put in place to prevent them from occurring.

On the basis of our experience, the most significant injuries in handball are:
- acute ankle and knee (ACL) injuries and
- overuse injuries to the shoulder and elbow.

**General screening in handball**

Unlike some other International Sports Federations (such as FIFA or the IOC), the IHF does not have a formal recommended screening programme. Therefore, the actual steps performed during the screening of handball athletes are determined by the individual screening institution. However, the basics remain consistent and three main areas are considered:

1. Assessment for illness risk (General Medical Screening).
2. Assessment of sudden death risk (Cardiac Screening).
3. Assessment for injury risk (Musculoskeletal Screening).

**The Aspetar approach**

In our hospital, players are assessed in two (or occasionally, three) sessions. In the first session (Stage 1), a full medical history is obtained, with an emphasis on family history, any history of cardiac symptoms and injury history. Sports and training history is also obtained. Furthermore, an electrocardiogram (ECG) is routinely performed. If there were any positive findings in the cardiac history section or any abnormalities in the ECG then the player is referred to one of our cardiologists for full cardiac evaluation. During the initial visit, blood testing is also performed. Our routine investigations include:

- Complete blood count.
- Ferritin.
- Inflammatory markers.
- Hepatitis and HIV serology.
- Fasting lipids.
- Fasting glucose.
- Urinalysis.
- Vitamin D, calcium, corrected calcium and alkaline phosphatase.
- Visual acuity testing.
- Respiratory assessment – spirometry testing, body plethysmography and Eucapnic Voluntary Hyperventilation testing (EVH) will be available in the future.
During the second visit (Stage 2), the history and all investigation results are reviewed by a sports physician and the player undergoes a full clinical examination, paying particular attention to the cardiorespiratory and musculoskeletal systems.

The musculoskeletal screening examination is adapted to each individual sport with an emphasis on those areas at highest risk of injury – in the case of handball, this includes both upper and lower limb in particular.

With the introduction of the Aspetar Injury and Illness Prevention Programme (ASPREV), all handball athletes will also undergo a physiotherapy assessment, including range of motion measurement, isokinetic and strength testing.

Athletes are referred to the Sports Science Department (including Sports Physiology, Sports Psychology and Podiatry) and the Nutritional Department as necessary.

Stage 3 visits are arranged for those athletes to whom further investigation is warranted. The results of the investigations can be discussed and a decision on fitness to play can be made after further clinical assessment.

HANDBALL SCREENING AND ACL INJURIES

Although female gender and previous history of ACL rupture are recognised risk factors for ACL injury, these risk factors cannot be corrected. None of the static musculoskeletal measurements such as joint range of movement or flexibility typically performed in screening medical assessments have been identified as risk factors for non-contact ACL injury.

It has been shown that knee valgus motion is an important component of ACL injury mechanism and knee valgus angle and abduction moment on jump landing tests and electromyography (EMG) patterns during side cutting have been reportedly enhanced to ability to identify female athletes at risk of ACL injury.

Dempsey was able to reduce knee abduction moments by getting players to perform cuts with the stance foot closer to the midline and the trunk more erect, although whether this is effective in reducing knee abduction moment during a live match situation is not yet known. Kristianslund has shown that toe landing from jumps also reduces knee abduction moment, not by reducing the ground reaction force as expected, but by allowing players to align their lower extremity to reduce arm moments.

Zebis et al tested the EMG activity of 55 elite female handball and football players during a standard side cutting manoeuvre and then followed the players over two seasons. They found that those with reduced semitendinosus EMG pre-activity and increased vastus lateralis pre-activity were at increased risk of future non-contact ACL injury. This suggests that training programmes should focus on medial hamstring up-regulation. This study was small, however, and needs larger prospective studies to confirm the findings but EMG testing is not readily available to many teams.

Myer developed an algorithm to accurately identify young female athletes with high knee abduction moments in order to be able to target them for injury prevention training. Measurements performed include tibia length, knee valgus motion and knee flexion range of movement on a drop vertical jump, body mass and quadriceps:hamstring strength ratio. These measurements can be performed without access to a dedicated biomechanics laboratory or expensive laboratory equipment (two video cameras and a laptop computer) and the software is available as freeware. Future research is required to see if identifying those at increased risk improves the effectiveness of rehabilitation exercises to reduce knee adductor moment on landing.

ACL INJURY PREVENTION PROGRAMME COMPLIANCE

Effective reduction in ACL injury rates can also be achieved without identifying those at increased risk of ACL injury by introducing training programmes to whole teams. Mykelbust reported that a neuromuscular training programme in elite female handballers from the top three
divisions of female handball in Norway, using a wobble board, balance mat and handball-specific exercises delivered by physiotherapists reduced the incidence of ACL injuries from 0.43 to 0.33 ACL injuries per team. Even with the engagement of physical therapists to take charge of the delivery of the programme, compliance with the programme was still variable. The risk of injury was, however, much lower among the teams who completed the prevention programme.

Despite the success of this programme and the teams being allowed to keep the equipment (wobble boards, balance mats and DVD with the exercise programme), the ACL injury rate gradually increased over the next few seasons and it was discovered that few teams were still using the prevention programme when the physical therapists did not take charge of the programme in future seasons.

Subsequent to this, other initiatives were used to try to increase the use of the preventative exercises by giving coaches a DVD at coach-targeted seminars, the launch of an injury prevention website and widespread publication in handball circles of the success of an injury prevention programme in junior handball players, showing a reduction in lower limb injury by 49%. These measures did lead to a sustained further reduction in ACL injury rates, although it is not known which of these initiatives was most effective.

More recent research has concentrated at looking at sets of dynamic tests, termed functional muscle screening (FMS). This has shown some promise in being able to identify athletes at increased risk of injury in general (not just ACL injuries) with the hope that correcting these abnormal movement patterns will also reduce the incidence of injury.

SCREENING AND SHOULDER OVERUSE INJURIES
There is little in the literature on risk factors for shoulder pain in handball players. In a study of 613 elite overhead athletes including handball players, Mohseni-Bandipai reported that female gender, body mass index, years of practice, days of practice per week, level of sport and satisfaction with income were significantly correlated with the prevalence of shoulder pain. So one strategy to reduce shoulder pain might be to increase pay and decrease training!

Studies on handball players have noted a significant increase in shoulder external rotation and reduction in internal rotation in the throwing shoulder compared with the non-dominant arm, however there was no significant difference in total joint range of movement between the dominant and non-dominant arms. Mykelbust also noted that there was no difference in shoulder total range of movement between those with current or previous shoulder pain and those with no history of shoulder complaints. She concluded that these adaptations were not directly associated with shoulder pain.

Pieper however reported in a population of 51 male professional handball players, that those who had not developed humeral retro torsion, which is hypothesised to develop as an adaptation to allow more shoulder external rotation, seemed to have more shoulder symptoms than those with retro torsion.

Mykelbust found that 29% of female players had shoulder pain with an anterior relocation test and that the rate of positive tests was significantly higher in those with shoulder symptoms at the time of the test. She hypothesised that shoulder instability might be a cause of shoulder pain in handball players.

Interest has been shown in the importance of shoulder muscle balance in the prevention of injuries. It has been suggested that eccentric shoulder external rotation (ERecc) strength should be greater than concentric internal rotation (IRconc) strength in order to be able to decelerate the rapidly internally rotating arm in the follow-through phase of the throw. Andrade Mdos reported that functional ERecc:IRconc ratios of less than 1.0 were
associated with shoulder injury in volleyball players. Edouard et al\textsuperscript{11} found that in their study group of youth female handball players, those with an imbalance between ERecc and IRconc strength (ratio less than 0.67) had an increased risk of shoulder injury with a relative risk of 1.50 (95\% CI 0.83 to 2.17), and those who developed injury had a significantly greater reduction in ERecc:IRconc compared to the non-dominant side than those who did not get injured. The numbers were small and with the statistical confidence intervals crossed the value 1 – and were therefore not statistically significant – but more research is warranted into the role of strength imbalances as risk factors for future shoulder injury. More research is therefore needed into the identification of risk factors associated with the risk of developing shoulder pain in handball players.

SCREENING AND ANKLE INJURIES

There is also little in the literature on risk factors for ankle injury in handball players. In most sports, the only consistently reported risk factor that is predictive for a new ankle injury is a previous history of ankle injury\textsuperscript{8}. However, in their study of Norwegian professional footballers, Engebretsen et al\textsuperscript{12} found the positive predictive value to be low, with only 6\% of those with a previous history of any ankle injury sustaining a subsequent ankle injury in the following season. This increased to 10\% if there was a history of multiple previous ankle injuries and to 9\% if there had been an ankle injury in the previous 10 months. Furthermore, they also found that 26\% of ankle sprains occurred in players with no history of ankle sprain\textsuperscript{9}. Therefore when instigating a programme to prevent ankle injuries, if those with a previous history of ankle sprains are the only ones targeted, a significant proportion of future injuries will be missed.

Several studies have shown that, looking at a variety of sporting populations, the rate of ankle sprains can be reduced either by neuromuscular training or with the use or orthotics or bracing, particularly in previously injured players\textsuperscript{13}. The benefit of bracing or orthotics seems to be consistently effective.

TAKE HOME MESSAGES

Performing a periodic ‘screening’ health examination on handball players serves many useful purposes in addition to the search for illness and injury implied by the word ‘screening’, and it may be better to call these periodic health examinations rather than screening medicals.

Aspetar is planning a prospective cohort study on risk factors for injury and illness in handball players. Data from annual screening medicals will be added to injury and illness data, exposure data, performance and fitness data as well as sleep and recovery measures. It is hoped that in time these data will be able to explore the complex interactions between the multiple potential risk factors in order to identify situations in which athletes are at risk of becoming ill or injured so that preventative strategies can be put into place.

References at www.aspetar.com/journal