

CONCUSSION IN PARA SPORT

– *Written by James Kissick, Canada and Nick Webborn, United Kingdom*

In their editorial “Fifty shades of grey: concussion complexities and constructive conclusions”, Patricios and Makdissi refer to concussion in sport as being “a grey area about grey matter”, as much of concussion definition, assessment and management remains ill-defined¹. Nowhere is this truer than with concussion in para sport. While the subject of concussion is a very prominent one in the medical and scientific literature, with a rapidly increasing amount of research, there is a paucity of studies and clinical guidance on concussion in para athletes. With para sports, particularly the Paralympics, being broadcast to an increasingly larger audience worldwide, advances in knowledge may guide appropriate care of athletes participating in disability sport at all levels.

It is imperative that we learn more about concussion in para sport to keep these athletes safe by reducing their concussion risk and to allow best practice assessment and management. This article will summarise what is known through

existing research and point out the potential challenges (and opportunities) in assessment, management and risk reduction.

INCIDENCE

Van Mechelen et al proposed a four-step model of injury prevention, where the first step is to identify the extent of the injury problem through injury surveillance². Once this information is obtained, risk factors and mechanisms of injury can be established, allowing prevention strategies to be developed. While there are several para sports where one would anticipate a greater risk of concussion, there is very little incidence data.

The International Paralympic Committee has conducted injury surveillance studies at the Winter Paralympic Games since 2002 and the Summer Paralympic Games since 2012. While the incidence of head, face and neck injuries was determined, until the Rio 2016 Games, the incidence of concussion was not measured.

The injury surveillance questionnaire, which national team physicians were asked to complete at the 2016 Rio Games, contained specific questions about concussion. A preliminary review of the data indicates that 10 injuries to the head, neck and face were reported (including head/facial fractures), but none of these were identified as a concussion³. The authors of this paper both witnessed several injuries during Football 5-a-side matches (visually impaired football) where there was a clear blow to the head followed by apparent balance issues in the player, yet none of these were reported as a concussion. This concern was supported by review of video footage of the matches. While it is not possible or appropriate to diagnose a concussion from the stands, this may well speak to the need for concussion education for players, officials, coaches and healthcare staff.

Football 5-a-side appears to be a sport with a high risk of concussion. Players are visually impaired and wear eyeshades to ensure all have an equal total lack of vision



(the goalkeepers on each team are sighted). The ball has a bell in it and players not in possession of the ball are required to call out to identify their presence when moving towards the ball. The possibility of head collision at running speed is high as players tend to be in an upright position and have no anticipation of impact. Webb et al evaluated the rate of head and face injuries at the 2012 Paralympics and found a high incidence, albeit with a small total number of injuries: three of 22 injuries or 13.6% of all injuries. This is contrasted with a 2.2% rate of the same injury in the total Games population. Football 7-a-side or CP Football, is played by athletes with cerebral palsy; here the rate of head and face injuries was 1 in 14 or 7.1%⁴. Magno e Silva et al found that in 13 international visually impaired Brazilian footballers, head injuries made up 8.6% of all injuries over 4 years (five competitions)⁵.

Wheelchair basketball is a fast paced and supposedly non-contact, game but has a high rate of collisions between players sometimes resulting in concussion. Wessels et al looked specifically at concussions in players by self-report survey of 263 athletes ranging in age from 18 to 60 participating

in tournaments over the 2009/10 season. Concussion symptoms were reported by 6.1% of players but 44% did not report it for fear of removal from play. This is similar to the reported incidence in able-bodied basketball. Females had a 2.5 times higher rate than males, but there were a limited number of females in the study⁶.

Intuitively, one would expect a risk of concussion in winter sports such as alpine skiing and snowboarding, which involve athletes with physical or visual impairments reaching high speeds on often icy slopes. Similarly, in para ice hockey (sledge ice hockey), where body contact or collision into the side boarding is part of the game. However, there have been no reported concussion incidence in the four iterations of the IPC Injury Survey at Paralympic Winter Games. While purely anecdotal, the author (JK) has been involved in the care of several visually impaired skiers, who identified that concussion is not uncommon in their sport. At the 2010 Winter Paralympics, Hawkeswood et al surveyed team representatives (physician, therapist, coach manager), from each of the top ranked para ice hockey teams. Concussions

were reported as a major concern by the respondents, with bodychecking identified as the likely mechanism⁷. The IPC again included specific questions regarding concussion as part of its injury surveillance at the 2018 Winter Games in Pyeongchang to attempt to collect data on these potentially higher risk sports, but clearly there is a need for athlete and physician education.

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In summary, while there is certainly anecdotal evidence and an intuitive sense from those involved in the care of para athletes that concussion is a risk (particularly in speed, collision or visually impaired sports), there is very little actual data. Referring to Van Mechelen's injury prevention model², we have not yet been able to achieve the first step. Clearly, it is critical that studies be done using consistent injury definitions (e.g. How is concussion defined?) and robust methodologies to allow progress toward the design and implementation of effective injury prevention strategies.

ASSESSMENT

One of the consistent mantras in sports medicine is 'know your athletes' and this is especially relevant in the discussion around assessment of the potentially concussed para athlete. The wide range of impairments that make up the para athlete environment means that the pre-morbid status is widely variable and communication difficulties or cognitive impairment could give a false impression to the clinician unfamiliar with his charges. Notwithstanding these challenges there remains the question of the validity of the concussion testing protocol for able-bodied athletes in the para athlete population.

There is minimal guidance on the assessment of concussion in para athletes in the literature. It is likely that most clinicians working with these athletes look to the existing consensus on concussion

assessment in the general sport population for guidance and use existing tools such as the Sport Concussion Assessment Tool (SCAT). The recently published Consensus Statement on Concussion in Sport from the 5th International Conference on Concussion in Sport states; "The recognition of suspected SRC (sport related concussion) is therefore best approached using multi-dimensional testing guided via expert consensus. The SCAT₅ currently represents the most well-established and rigorously developed instrument available for sideline assessment⁸⁷". However, there are portions of this tool which are not appropriate, or may need to be modified, for use in the disabled population; for example, how does one perform balance testing on an athlete in a wheelchair? This is recognised by the Concussion in Sport Group and it is noted in an accompanying paper to the Consensus Statement that the systematic review performed for the development of the SCAT₅ found there was "scant information on the use of SCAT in athletes with disabilities, as well as across different cultures and language groups⁹". They call for a systematic approach to adapt the SCAT₅ for use in these populations.

As the SCAT tools have been in existence over a number of years, a significant body of normative data has been obtained. However, this is for the general sport population; might the para athlete population be different? Weiler et al evaluated SCAT₃ baseline scores in footballers and compared



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generalisable to all sports or teams, it does speak to the need for ongoing education on concussion assessment and management in the para sport world and the development of tools, which are clinically applicable.

MANAGEMENT

There are no specific management guidelines which have been published for para sport athletes with a concussion. The Concussion in Sport Group's Consensus Statement recommends removal of any athlete with a suspected concussion from the game, activity or practice, followed by a period of rest until symptoms resolve, then a graduated return to play protocol⁸. It would seem appropriate that Para athletes be managed in this way as well. This is the experience of the authors and other experienced clinicians working with athletes with impairment. However, it is possible that there may be specific nuances, depending on the injury, athlete and sport. For example, a brief initial period of rest (avoidance of any activities which provoke symptoms) has been a cornerstone of initial management. It may be significantly more difficult for an athlete using a wheelchair to physically rest given the need to propel the wheelchair and to transfer in and out of it. Other questions might include:

Should the return to play process be more gradual with some athletes? (e.g. the athlete with a ventriculo-peritoneal shunt).

Is computerised neuropsychological testing valid to determine if return to baseline has occurred? (and how do you implement this in a visually impaired athlete?).

As with assessment, ensuring that clinicians are aware of and kept up to date on management guidelines is critical. West et al's survey at the 2015 CP Football World Cup indicated that several clinicians were returning athletes to play faster than recommended by the Concussion in Sport Group's Zurich 2012 consensus. A number of these clinicians stated that they were unaware of any concussion guidelines¹⁴.

RISK REDUCTION

While much work needs to be done regarding the determination of the incidence and mechanism of concussion, risk reduction strategies based on our

scores between players with a disability and those without. They found significant differences: male visually impaired players scored better on total concentration and delayed recall; male CP footballers scored higher on immediate memory and recorded more errors on balance testing. Female players with hearing impairment scored higher for total concentration and balance error testing than female players without disability¹⁰. This supports the recommendation of the Concussion in Sport Group that a comprehensive set of norms needs to be established for the disabled athlete population, as well as for different language groups, sports and gender⁹.

There may also be issues with respect to knowledge of appropriate concussion assessment and assessment tools in the

Para sport world. In their editorial, West et al commented on experiences at the CP Football World Cup in 2015. Physiotherapists and physicians working with the competing countries were surveyed and most reported some education in concussion management and experience in managing a player with a suspected concussion. However, several stated they relied more on subjective factors like a good working knowledge of their players (as well as a high reliance on imaging) in making their assessment. There seemed to be a low rate of use of the SCAT3 or any other validated assessment tool¹¹. It was not identified why this was the case. Perhaps it was lack of awareness of the tools or possibly because these clinicians had not found them applicable or helpful in their athlete population. While this may not be

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current knowledge and experience should be implemented. In general, these strategies will take the same form as those for the general sport population, but with specific adaptation to the para athlete. This must be addressed in a sport-specific manner with the considerations for the collision potential, impact speeds, whether head protection is worn and if this meets appropriate standards. The impairment of the athlete may also increase the risk of collision, for example, the visually impaired athlete cannot see potential hazards. By targeting those sports with known increased risk from studies or those with potential theoretical risk, one can direct limited resources more appropriately for preventive strategies. Injury epidemiologist Sue Baker coined the “3 E’s of Injury Prevention” in 1973 and they have been widely used since by many injury prevention organisations: Education, Enforcement, Engineering²².

Education

As previously noted, there is a clear need for education on recognition, assessment and management in the para sport world. Wessels et al’s wheelchair basketball study found that 50% of those with a concussion did not report it since they did not know it was a concussion and 42% thought it was “part of the game⁶”. Education should be directed at multiple levels: athletes, healthcare providers, coaches, officials, sport administrators and in the case of younger athletes parents. Effective methods of ‘knowledge translation’ should be studied and the preferred methods of learning in each group considered in developing effective programmes. For example, clinicians in the CP Football study advised they would like to receive this through courses or online materials. Social media may be a more effective way to reach athletes. Educational interventions can also include advice on safe play techniques, for example, how to properly bodycheck in para ice hockey or tackle in football.

An important part of athlete education will be the recognition that some may not consider concussion as a big problem. The author (JK) has had several athletes tell him: “thanks for the information, doc, but I survived (cancer, major trauma etc), so I’m not really too worried about a bump on the

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head.” Many athletes may be ‘risk takers’. It is important to develop educational interventions which emphasise that, despite what they have experienced, protecting their brain is still critically important.

Enforcement

Enforcement refers to the rules of sport, which are put in place to ensure fair competition, but also to keep athletes safe. An example is para ice hockey’s ‘checking to the head and neck area’ rule. Research in able-bodied ice hockey has clearly shown that hits to the head are associated with an increased risk of concussion. Referees can enforce a more stringent penalty, which includes ejection from the game, if a player hits another player in the head. This could possibly also involve a suspension from additional games. This would have a significant impact on that player and his team, so it is designed as a deterrent to unsafe play. In Football 5-a-side the lack of enforcement of the ‘voy’ rule (for the defending player to call out “voy” – meaning “I’m going” in Spanish) to warn the player in possession of the ball of an approaching opponent, is another example. If players are penalised more frequently then this may reduce the frequency or severity of impacts.

Engineering

Engineering refers to of modifications to the sport and athlete environment,

which includes the venue, field of play and equipment. The unique nature of some para sports means that protective equipment may not have developed appropriately to the adapted form of the sport. For example, in para ice hockey, standard ice hockey protective equipment was used until five lower limb fractures were identified in a study at the 2002 Paralympic Games. Following this study changes were made in mandatory leg protection and sledge height and have a significant impact on safety in that sport with no lower limb fractures identified in subsequent surveys.

The problem of head collisions in football 5-a-side described in the ‘incidence’ section above outlines the issue. Players coming together as they compete for the ball tend to be in an upright position and head collisions are common. However, the lack of vision means that the contact with the opponent cannot be anticipated, which removes any anticipatory avoidance or pre-tensioning of muscles. As players are required to wear eyeshades to ensure equal lack of vision, it was postulated that a combined eyeshade with head protection might confer a protective benefit from concussion. The benefits of head protection in concussion prevention are a subject of debate of their success, but the majority of research has taken place in high impact sports such as American football and rugby union which may not be directly comparable.

Consequently, pilot work is being undertaken using a wearable sensor system to measure linear acceleration and also estimate angular acceleration. The sensor will be attached to the mandatory eyeshade of the players. The sensor will also monitor the most frequent points of impact thus identifying the areas most needing protection. When combined with the clinical data following head collisions and its consequences, it may then be possible to design protective equipment that combines eyeshade and head protection with materials that can defend against the measured forces.

A CALL TO ACTION

The systemic reviews done for the 5th International Conference on Concussion in Sport underscored the burgeoning amount of research on concussion. However, there is as yet a lack of information on concussion in athletes with disabilities. We say “as yet”, as we believe this is not only a critical area which needs to be studied, but also a great opportunity for clinically important research. Incidence data, mechanisms of injury, assessment, management and risk reduction all are ripe for study and inquiry, which will play a vital role in helping para athletes and all athletes with disabilities, compete safely. The recent editorial in British Journal of Sports Medicine highlights the need for researchers, clinicians and sports governing bodies to come together to address this issue³³.

FOR THE TEAM PHYSICIAN

- Be aware of the concussion risk in para sports. This may be obvious in some sports given their speed (e.g. para alpine skiing), contact (e.g. para ice hockey, wheelchair basketball) or visual impairment (e.g. football 5-a-side), but there is also a risk in sports where it might not be expected, such as para athletics, where crashes can occur in wheelchair racing.
- Use of existing assessment tools like the SCAT5 is helpful, but portions may not be useful in certain para athletes (e.g. modified Balance Error Scoring System testing in wheelchair athletes).
- An initial period of rest may be more difficult for some athletes (e.g. wheelchair athletes)

- As with all concussed athletes, a graduated return to play approach is recommended, but progression may need to be customised depending on the sport and athlete impairment.
- It is important to educate athletes, who may minimise the importance of concussion given previous illness or injury experience. Education of coaches, officials, healthcare providers and for younger athletes parents, is also critical.

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