PRINCIPLES OF INJURY PREVENTION IN THE PARA ATHLETE

– Written by Nick Webborn, United Kingdom and Peter Van de Vliet, Germany

Protecting the health of athletes has been recognised as one of the key issues for sports medicine. Prevention of injury is an integral component of that aim which can only be achieved through ongoing surveillance and audit to make evidence-based changes to rules, equipment, training practices and other technical aspects of the sport. The impact of these changes on future injury incidence can then be measured and monitored. While this is a relatively simple statement, the practical implementation of this in any sport can be challenging. The complexities involved in para sport and for the para athlete add a different dimension. The principles of injury prevention are the same, but new levels of intricacy must be considered in relation to different impairment types. Over the course of this article we hope to inform, stimulate and challenge the reader. With 22 summer sports and six winter sports at Paralympic Games it will be impossible within the scope of this article to address all injury prevention issues in all sports but we aim to provide an insight into the issues and the approach taken. Indeed, one of the challenges is the regular addition of sports to the Paralympic programme. For example, in Tokyo 2020, taekwondo and badminton will be added to the programme and so one of the problems is that there is often limited or no epidemiological information on which to base injury prevention strategies.

It is outside the remit of this article to cover in depth the sports, impairment types and classification systems used in para sport but further information about the background to the Paralympic movement and the various sports can be found in a previous issue of the Aspetar Sports Medicine Journal (Volume 5, 2016, Targeted Topic 9). However, in brief, from a classification perspective there are 10 different types of impairment which may make a person 'eligible' to participate and different degrees of that impairment that may determine the 'class' that an eligible athlete participates within. It is a complex process but in its simplest form tries to match athletes by the impact of their impairment on their ability to undertake the tasks of the specific sport. However, from a medical risk perspective, an understanding of the medical condition is important. For example, for the athlete with a spinal cord injury, their motor level will determine their degree of function for sport classification but other factors e.g. thermoregulatory impairment or loss of sensation may affect their risk of illness or injury.

INJURY PREVENTION PRINCIPLES IN PARA SPORT

While some authorities insist that biomechanics of the sport are the most

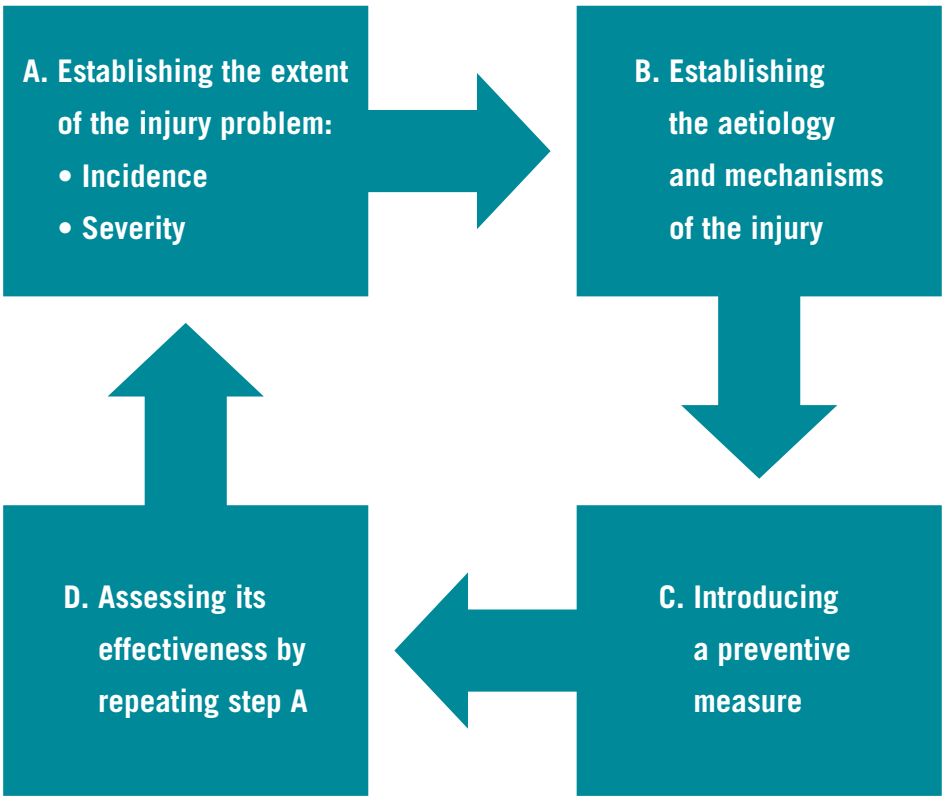

Table 1: The van Mechelen model on injury prevention.

important aspect of causation of injury, we do not wholly agree as there are many other variables, including for example, age, gender and fitness. However, it is clear that the anatomical structures injured can be directly related to the biomechanics of the sport. A good example of this would include wheelchair racing which, to the unobserved eye, consists purely of a group of athletes pushing a wheelchair around the track. However, different degrees of impairment will impact on the push technique based on the muscles available to provide the power e.g. the ability to recruit trunk muscles or not, or the athlete with a high spinal cord injury who has no handgrip. The forces placed on the push ring to provide the momentum for racing will put different loads on different joints in different ways depending on these factors. So understanding the sport, the impairment type, impairment level and the biomechanical differences can influence the injury risk and may need different prevention strategies.

Many of the published studies on injury epidemiology fail to address these issues and tend to group athletes more generally (e.g. 'wheelchair users'). This lack of specificity inevitably led to blurred information and gave no clear pathway for injury prevention. Various recent reviews of the literature[1-3] have all highlighted many of the deficiencies of previous work including the lack of longitudinal studies, exposure data, varying definitions of 'injury' and 'time loss'. However, it is clear that the principles of injury prevention are exactly the same as in able bodied athletes, and we will discuss some examples of how these have been applied in different sports.

Anyone with an interest in the area of sports injury prevention will be familiar with the four-step approach of Willem van Mechelen's "sequence of prevention[4]" model and this article would be remiss not to mention it as well. Indeed, this is probably the figure that you will see most commonly if you have attended any of the IOC injury prevention conferences (Figure 1). The Paralympic Injury Surveillance Programme that has been operational at Winter Paralympic Games since 2002 and at Summer Paralympic Games since 2012 has used this model as a basis for identifying the injury issues in para sport that need to be prioritised and working with International Federations to address the problems with, for example, education, or rule or equipment changes.

TRANSLATION OF RESEARCH INTO PRACTICE

One of the recurring challenges for researchers in the area of injury epidemiology and sports injury prevention is ensuring that findings are translated into practical steps that can be implemented by the governing body or by transferable knowledge to athletes, coaches or healthcare providers, so that it can have a true impact rather than remaining theoretical only. This is described by the evolution of the van Mechelen model into the Translating Research into Injury Prevention Practice framework (TRIPP)[5]. We have been fortunate that the IPC has embraced the concept of injury prevention through its games time injury surveillance programme and ongoing support. The IPC is also in a unique position in that it is also the International Federation for four summer and five winter Paralympic sports and therefore responsible for these athletes' welfare, which is a distinct difference to the IOC. In the remainder of this article we will give three examples from different sports where a problem has been identified and principles of injury prevention applied.

PARA ICE HOCKEY AND LOWER LIMB FRACTURE

It was perhaps fortunate that the first injury survey conducted at a Paralympic games by the IPC (Salt Lake 2002 Winter Games) produced findings that resulted in positive steps which were later shown to reduce the risk of injury in para ice hockey[6]. Para ice hockey is based on the rules of the International Ice Hockey Federation, but with some modifications. Instead of skates, players use double-blade sledges that allow the puck to pass underneath. Players use two sticks, which have a spike-end for pushing and a blade-end for shooting. During the

2002 competition there were five lower limb fractures identified in para ice hockey – the highest cause of lower limb fractures across all sports at these Games.

The protective equipment at that time was based on standard ice hockey equipment and failed to recognise the potential for injury due to the different position of the player and the lack of any mandatory leg protection. The sledge of one player could directly collide with the legs of another player resulting in direct trauma, compounded by the fact that athletes with long-term mobility impairment commonly have reduced bone density. Following this observation, the IPC Medical Committee made recommendations to the International Federation and the following rule changes were made:

1. The height of each sledge must be within a certain limit, to try to ensure that collisions occur sledge against sledge, rather than sledge against leg.
2. Mandatory leg protection was introduced.

Since that initial study, there have been three further editions of the Winter Paralympic Games with these amendments made to the regulations, and there have been no further lower limb fractures during competition identified by the injury survey system. Furthermore, the success of that study helped persuade the IPC that injury and illness surveillance should be instituted at all Paralympic Games and at London 2012 the first comprehensive injury and illness surveillance at the summer games was undertaken. With approximately eight times the number of athletes at a summer games, this required significant increase in the resources and manpower, which the IPC have not only agreed to support, but have now instituted as part of the mandate of the IPC Medical Committee during the Games.

> ***The long-term consequences of injury in sport have potential for greater impact on the future health of the para athlete***

TRACK AND FIELD ATHLETICS

Track and field athletics comprises the largest number of athletes competing within an individual sport at the Paralympic Games – approximately one quarter of all athletes participating in all sports at the Games. It also includes athletes with a diverse variety of impairment types, making it one of the most complex subjects for epidemiological analysis when considered alongside the large number of different disciplines within athletics. The first comprehensive study at the Paralympic Games identified that athletics had the sixth highest incident rate (22.1 injuries per 1000 athlete-days) of all Paralympic sports at London 2012, and so given the size of the cohort deserved specific attention for further analysis[7]. This paper started to tease out some of the individual issues for consideration and, in particular, more detail in relation to shoulder pain in the wheelchair athlete.

The broad-brush term, 'wheelchair athlete' has been used in a variety of papers which have shown that shoulder pain is a common feature amongst the wheelchair track athlete. However, when comparing this group of athletes against ambulant track athletes they had the lowest incident rate (IR 10.6) and also less than half that of seated throwing athletes with similar impairments (IR 23.7). Also, if we consider wheelchair track athletes as a separate group, in comparison to all other Paralympic sports at the Games, they had one of the lowest injury incidences altogether.

This discipline and impairment-specific data sheds light on the sport-specific issues for shoulder injuries which allows consideration for aggravating factors, i.e. the throwing action and consequently, implications for prevention. To facilitate the transfer of knowledge into injury prevention practice, the IPC Medical Committee organised a seminar at Aspetar for coaches and medical staff during the 2015 World Championships in Doha.

RESIDUAL LIMB PROBLEMS AT PARALYMPIC GAMES

For the athlete with a lower limb prosthesis and the team physician, one of the key factors in ensuring continued participation to achieve sport performance is the health of the tissues within the residual limb. Maintaining the health of the tissues at the interface between the prosthetic and the limb is essential. Constant monitoring of the tissues following training, travel and in daily life are critical. Changes in volume of the residual limb will occur in the acute phase of training/competition in relation to blood flow and muscle activity, as well as chronically due to adaptation of tissues due to the load of training. Consequently, consistent appraisal of the fit of the prosthetic, and any reaction to acute training loads, must be observed. Skin may chafe and breakdown in response to sheer or impact forces. Excessive sweating within the prosthetic may also exacerbate skin breakdown and lead to infection. Long haul travel may also affect the volume of the residual limb, making it difficult to fit the prosthetic device on arrival. Wearing of the silicone stump liner during the flight, for example, may help to mitigate this in the same way that compression stockings are used by other travellers to control lower limb swelling.

There is also a further challenge for the amputee athlete when entering the games environment that may lead to an increased risk of skin breakdown if not considered and prepared for. Unlike a normal training day or even a World Championships, the Paralympic Games village environment creates an additional walking load. There are often considerable distances between the athlete accommodation, dining hall, transportation and competition venue. A pedometer study of Paralympics athletes comparing number of steps between home training and the Paralympic Games environment found an 83% increase (average 5472) in the number of steps taken per day[8]. Apart from the fatigue that may occur from this and the additional energy expenditure that needs to be considered, it is also an 83% increase on loading of the tissue at the residual limb interface, which could lead to tissue breakdown. Education of the athlete about this possibility and preconditioning for this additional walking load needs to be considered as a preventive measure.

SUMMARY

Injury prevention is still within its relative infancy in para sport but has been consistently gaining momentum and interest from the academic community over the past few years. The complexities added by different impairments and different equipment make it more challenging in many respects, but for the enthusiastic researcher it offers opportunity, as so much is yet to be discovered. With new sports being regularly added to the Paralympic programme we enter further uncharted waters, but sticking to the application of the principles of injury prevention and translation into practice will serve us well.

Also in need of critical evaluation are the long-term consequences of injury on the future health of para athletes and, in particular, that of upper limb injury in wheelchair-dependent athletes[5]. These athletes rely on upper limb function for activities of daily living and injury can have a critical impact on their future quality of life. Rotator cuff tears or early glenohumeral joint degeneration will impact their ability to transfer safely to and from the wheelchair. Also important is the care of the residual limb as progressive damage could ultimately limit weight-bearing function. Development of long-term injury surveillance programmes that encompass training and competition will provide data to guide the future focus of injury prevention. Long-term studies of retired athletes will tell us how successful we have been!

TAKE HOME MESSAGES

- The principles of injury prevention in para athletes are the same as for their able-bodied peers, but with added levels of complexity related to different impairment types, sports and equipment
- Epidemiological studies that are sport- and impairment-specific are necessary for prevention strategies.
- Adaptation of equipment and regulations in para ice hockey has reduced the incidence of lower limb fracture at Paralympic Games.
- Lower limb amputee athletes are at risk of skin breakdown with travel and increased walking distances at major events, in addition to sport-specific loading.
- The long-term consequences of injury in sport have potential for greater impact on the future health of the para athlete.

References

1. *Weiler R, Van Mechelen W, Fuller C, Verhagen E. Sport Injuries Sustained by Athletes with Disability: A Systematic Review. Sports Med [Internet]. 2016 Aug [cited 2017 Feb 10];46(8):1141–53. Available from: http://www.ncbi.nlm.nih.gov/pubmed/26846430*
2. *Webborn N, Emery C. Descriptive Epidemiology of Paralympic Sports Injuries. Pm&R [Internet]. 2014 Aug [cited 2014 Aug 16];6(8):S18–22. Available from: http://linkinghub.elsevier.com/retrieve/pii/S1934148214002767*
3. *Fagher K, Lexell J. Sports-related injuries in athletes with disabilities. Vol. 24, Scandinavian Journal of Medicine and Science in Sports. 2014.*
4. *van Mechelen W, Hlobil H, Kemper HC. Incidence, severity, aetiology and prevention of sports injuries. A review of concepts. Sports Med [Internet]. 1992 Aug [cited 2017 Feb 17];14(2):82–99. Available from: http://www.ncbi.nlm.nih.gov/pubmed/1509229*
5. *Finch C. A new framework for research leading to sports injury prevention. J Sci Med Sport. 2006;9(1):3–9.*
6. *Webborn N, Willick S, Reeser JC. Injuries among disabled athletes during the 2002 Winter Paralympic Games. Med Sci Sports Exerc. 2006;38(5):811–5.*
7. *Blauwet CA, Cushman D, Emery C, Willick SE, Webborn N, Derman W, et al. Risk of Injuries in Paralympic Track and Field Differs by Impairment and Event Discipline: A Prospective Cohort Study at the London 2012 Paralympic Games. Am J Sports Med [Internet]. 2016 Feb 26 [cited 2016 Mar 11]; Available from: http://www.ncbi.nlm.nih.gov/pubmed/26920432*
8. *Burkett B. Is daily walking when living in the Paralympic village different to the typical home environment? Br J Sports Med [Internet]. 2010;44(7):533–6. Available from: http://www.ncbi.nlm.nih.gov/pubmed/20418522*
9. *Webborn N. Lifetime injury prevention: the sport profile model. BJSM. 2012;46(3):117–21.*

Nick Webborn O.B.E., M.B.B.S., F.F.S.E.M., F.A.C.S.M., F.I.S.M., M.Sc., Dip.Sport.Med

Centre for Sport and Exercise Science and Medicine (SESAME), School of Sport and Service Management

University of Brighton

Brighton, United Kingdom

Peter Van de Vliet Ph.D.

Medical & Scientific Department,

International Paralympic Committee

Bonn, Germany

Contact: nickwebborn@sportswise.org.uk