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Cover photograph: Australian Sports Commission

A tasting plate of conference speakers

Gary Moorhead

For the benefit of readers considering attending the Sports Medicine Australia national conference -- this year badged "*be active '07*" and to be held in Adelaide from 13–16 October -- the major speakers at the Conference have contributed to this article, the aim being to reveal a little more about them, their backgrounds and interests.

All speakers were asked to respond to the following four questions:

1. What do you consider the most important piece of work or research you have undertaken and why (or of which you are most proud)?

2. What persons, events or specific research had a significant influence on your career development?

3. What is the most exciting project you have planned for the future?

4. What single piece of advice would/could you give to policy-makers seeking to turn research into policy and practice in your field?

Satisfying for an organisation like SMA which promotes multidisciplinary information-sharing and problem-solving, the responses reflect the different disciplines and backgrounds from which the speakers are drawn. They also give a fascinating "taster" of what is to come in Adelaide in October.

More details about the speakers can be found at http://www.sma.org.au/ACSMS/2007/speakers/default.asp

1. What do you consider the most important piece of work or research you have undertaken and why? (Or of which you are most proud).

"In 2003-4 I led a study funded by the National Heart Foundation investigating the mechanisms underlying socioeconomic inequalities in physical activity and diet among women. This work is important as it's among very few studies internationally that have attempted to move beyond merely documenting socioeconomic gradients in these key health behaviours to investigating the underlying pathways by which socioeconomic disadvantage contribute to increased risk of sedentary lifestyles and poor diet. We identified a range of personal, social and environmental factors that are potentially important and might be key intervention points for strategies aimed at promoting physical activity and healthy eating among socioeconomically disadvantaged groups." (**Kylie Ball**)

"A kinetic, kinematic and EMG study of the effect of football boot midsole height on hamstring muscle activity" - because it led directly to a fairly radical change in thinking on football boot design, and ultimately the production of a commercially available football boot that we believe may directly influence injury." (**Simon Bartold**)

"An article published in Arthritis and Rheumatism in 2004 (Vol 50, pp 3306-3313) entitled "The "enthesis organ" concept: why enthesopathies may not present as focal disorders. This article has had a very important impact on clinical rheumatologists who have begun to recognise that enthesopathies should not necessarily be regarded a focal problems, but as multifocal disorders. It helps them understand why patients present with the symptoms they do. (**Michael Benjamin**)

"Two immediately come to mind: first, a 1989 paper on cardiac respiratory fitness and mortality which revealed the protection that could be derived from moderate fitness – this changed a prevailing mindset and has been cited more than 1200 times; second, the first paper I published showing it was possible to be active, fit and healthy, regardless of weight." (**Steve Blair**)

"The development and evaluation of computer-tailored health education - I was one of the first to work in this field. Also, a series of systematic reviews I was involved in as a project leader on the association of physical and social environmental factors with physical activity and nutrition. Many claims have been made that the obesogenic' environments are the main driving force behind the present obesity epidemic, but our reviews show that there is not much scientific evidence yet supporting the fact that such environmental factors are strongly associated with obesogenic behaviors." (**Johannes Brug**)

"I participated in a few studies that found that exercise (alone) was effective in reducing rates of falls in older adults." (**David Buchner**)

"Most proud of: research into the incidence and determinants of injury affecting female gymnasts. My work was the first prospective cohort research to document the nature and incidence of injuries affecting competitive female gymnasts which used exposure data (ie, hours and athletic exposures) as a basis for determining injury rates and for testing risk factors of interest. Perhaps most important: co-editor (with N. Maffulli) of two edited volumes on the 'Epidemiology of Pediatric Sports Injuries' in Karger Publishers' Medicine and Sport Science book series. These were the first published volumes on the epidemiology of injury in pediatric sports." (**Dennis Caine**)

"Probably my single most important work has centred on creation of a theoretical model that uses an hourglass and inverted triangle as heuristics in attempting to account for both the 'products' and 'processes' of motor development, respectively. When this information is combined on an individual learner level with what we know about the process of movement skill learning, we gain essential information for guiding us in the

selection and use of a wide spectrum of teaching styles." (**David Gallahue**)

"The research I've conducted on the psychological aspects of sport injuries is pleasing because of the feedback I receive regularly from colleagues overseas who find the applied implications particularly helpful in the professional training of physical trainers. I'm also proud of the contributions my students and I have made in the career transitions area, which is now a staple topic in most conferences world-wide." (**Sandy Gordon**)

"To develop the RESTQ-Sport in a series studies and to get it published with a high ranked publisher. And of course seeing the RESTQ-Sport used in practice and in research by other researchers. Also to have the first book edited focusing on recovery in sport. Kellmann M (Ed): *Enhancing Recovery: Preventing Underperformance in Athletes*. (**Michael Kellmann**)

"All of my research has relied on colleagues and teams so, keeping in mind the collegial nature of the research, I feel that contributions to the field of tendinopathy research, stress fracture management, and exercise prescription in frail populations have made a difference to improving patient outcomes." (**Karim Khan**)

"I cannot identify one particular piece of research that is most important, but I have especially focused on the energy and nutritional needs of active women across the lifecycle and their unique relationship with food and body image." (**Melinda Manore**)

"Most important: (a) New Paradigm: Impact forces, soft tissue vibration and muscle tuning. Application to shoes, surfaces and apparel; (b) New Paradigm: Instability of shoes and development of small muscles and stability." (**Benno Nigg**)

"This is tough - but recently the Fun 5 project (see http://www.hawaii.edu/publichealth/faculty/profile/nigg.html), because this is an award-winning dissemination project promoting physical activity and healthy nutrition in 20,000+ children across Hawaii." (**Claudio Nigg**)

"The work that showed there is no correlation between changes in the rearfoot motion with foot orthotics and clinical outcomes which is what is believed. Foot orthotics work, but for r easons other than changing rearfoot motion." (**Craig Payne**)

"Research soon to be published demonstrating that a 12 week behavioural intervention conducted by an exercise physiologist increased physical activity levels in sedentary people with chronic disease beyond the National Guidelines at 12 weeks with these levels being maintained independently at 12 months with no ongoing professional follow up." (**Daryl Sadgrove**).

"The studies performed together with my colleagues were among the first to show that physical exercise may have a profound effect on ageing skeletal muscle, connective tissues and bone. The evidence extending from the cell and tissue level structure and function of muscles and bones to the "whole body" measures of physical performance clearly illustrated the adaptability of the ageing musculoskeletal and cardiovascular system." (**Harri Suominen**)

2. What persons, events or specific research had a significant influence on your career development?

"Having a wonderful team of colleagues in the Centre for Physical Activity and Nutrition Research at Deakin. I've now been working with this group for eight years and still enjoy every day!" (**Kylie Ball**)

"My father for suggesting I should become a podiatrist; Brian Sando for stimulating my interest in and encouraging my involvement in sports medicine; a chance encounter with Mark Doherty from ASICS which defined my interest and eventual passion for research into technical athletic footwear. This ultimately was to determine my working future." (**Simon Bartold**)

"The encouragement and belief in the importance of my work that has come from Professors Jan Gillquist and Karola Messner (Linköping, Sweden) and from Professor Dennis McGonagle (Leeds, UK)." (**Michael Benjamin**)

"My main advisor for my PhD, Professor Gerjo Kok, was very influential. Furthermore, at the start of my career I won a fellowship from the Dutch Cancer Society that allowed me to travel to the US and Canada where I met professors Lawrence Green, Karen Glanz and Vic Strecher. They influenced my research focus. Larry Green introduced me to his thinking about planned health promotion, Karen Glanz to systematic and stepwise research in behavioural nutrition, Vic Strecher was the key pioneer in computer-tailoring research." (**Johannes Brug**)

"The most significant influence on my career development was the Robert Wood Johnson Clinical Scholars Program. This two-year fellowship influenced me to do research in prevention and geriatric medicine." (**David Buchner**)

"My early work with Steven Roy MD (Eugene, OR) on 'Stress changes of the distal radial epiphyses in young female gymnasts' (AJSM, 1985). I had initially approached Steven regarding my interest in researching overuse injuries, particularly growth plate injuries, affecting young distance runners. Interestingly, Steven was seeing gymnasts in his practice who presented with stress injuries affecting the distal radius and invited me to work with him in tracking and describing these injuries. This work led next to my doctoral work on the epidemiology of injury affecting young gymnasts." (**Dennis Caine**)

"On a personal level: my wife Ellie has been immensely helpful throughout my career. On a professional level: the works of theorists such as Jean Piaget, Urie Bronfenbrenner, Erik Erikson, Nicoli Bernstein and others has served to help me think through issues of motor development and movement skill learning and most importantly what it means in practical terms for parents, teachers, coaches and therapists." (**David Gallahue**)

"Attending the University of Alberta (Canada) during unpaid leave of absence from the University of Aberdeen opened my eyes to both unimaginable research and career opportunities. Coming to Australia 20 years ago was also an unanticipated and unplanned epiphany." (**Sandy Gordon**)

"International contacts due to conference participation (eg, Craig Wrisberg, Cal Botterill, Mark Andersen)." (**Michael Kellmann**)

"I owe a huge debt of gratitude to so many SMA members that starting to name them here would take up the rest of the journal! But they know who they are! If I could point to a 'system' influence, I would say that the multidisciplinary nature of Australian sport and exercise medicine provided

a tremendously rich training ground. I benefited from the mentorship of physiotherapists, sports physicians, remedial massage therapists, exercise scientists and researchers in various disciplines. This provided unique insights that one-dimensional training can never match." (**Karim Khan**)

"Great mentors who believed in me and helped me as a new faculty member." (**Melinda Manore**)

"Professor Wartenweiler who attracted me from nuclear physics to biomechanics." (**Benno Nigg**).

"I will always point back to my Masters supervisor Dr. Kerry Courneya, who introduced me to this area and instilled an unparalleled motivation." (**Claudio Nigg**)

"Proving critics wrong." (**Craig Payne**)

"I continue to be strongly influenced by the passionate, enthusiastic and professional AAESS members who continue to break new ground and find new and exciting ways of doing things. As a professional I have benefited greatly from these relationships." (**Daryl Sadgrove**)

"Professor Eino Heikkinen who originally introduced me to the field of connective tissue and ageing research, and my doctoral students and colleagues, particularly Vuokko Kovanen, Sarianna Sipilä, Sulin Cheng and Marko Korhonen who have kept me involved in active research work besides all administrative duties." (**Harri Suominen**)

3. What is the most exciting project you have planned for the future?

"Based partly on the findings identified in our Heart Foundation study described above, my colleagues and I at Deakin recently won a major NHMRC Strategic Award to fund a five-year research program examining obesity risk, and strategies to prevent obesity amongst socioeconomically disadvantaged women and children." (**Kylie Ball**)

"Can't tell you. For the moment it is a secret, but it is HUGE!" (**Simon Bartold**)

"I never give too many details away of what I have not yet done, in case anyone beats me to it!! However, suffice it to say that it will be a project that largely centres on the attachment of the Achilles tendon." (**Michael Benjamin**)

"Two studies: one a study of a cohort of 5,500 children aged 15, the other a study of post-menopausal women looking at dose response." (**Steve Blair**)

"The HOPE project. This is an EU-funded project to bring all scientific projects on obesity prevention across Europe together to build a network of networks of researchers to help to gain further insight in the obesogenic environments and intervention possibilities. See www.hopeproject.eu. The project was launched in June this year." (**Johannes Brug**)

"The most exciting research project that I am currently involved in relates to the effect of incentives (eg, economic incentives) on physical activity levels in older adults." (**David Buchner**)

"I am working on a new co-edited volume (with P Harmer and M Schiff) for the IOC's Encyclopaedia of Sports Medicine book series. This book is titled 'Epidemiology of Injury in Olympic Sports' and includes 30 sport-specific chapters. This book should be published by early 2009." (**Dennis Caine**)

"Soon I will be retiring from professional life and, in addition to revising both of my textbooks – *Understanding Motor Development: Infants, Children, Adolescents & Adults* (8th Ed) and *Developmental Physical Education for All Children* (5th Ed) – I intend to devote my time and energies to our six grandchildren as well as to my passions of mountain climbing, a downhill skiing. My hope is to climb all 56 peaks over 14,000 ft (13 down, 43 to go)." (**David Gallahue**).

"Appreciative coaching applications to sport science, exercise and health domains excites me. I envision research opportunities in all three areas in the years ahead." (**Sandy Gordon**)

"Extending the Sport and Exercise Psychology Service at The University of Queensland for research and service." (**Michael Kellmann**)

"Can't say today, Gary, but hope to have news in a week." (**Karim Khan**)

"We are currently working on a diet and exercise intervention to determine how we might reverse menstrual dysfunction in active women. We are also very

interested in how we can help women have better relationships with food, so they view food as something that fuels their sport and something to be enjoyed, not feared." (**Melinda Manore**)

"Many". (**Benno Nigg**)

"Again, there are several but one that will have a profound impact is the analysis of one of my projects which is testing some of the criticisms and underlying assumptions of the Transtheoretical Model of Behavior Change." (**Claudio Nigg**)

"Determining how foot orthotics work so they can be better prescribed." (**Craig Payne**)

"Submissions to government for the broader recognition of exercise physiologists and new models of care for chronic disease management." (**Daryl Sadgrove**)

"The association between obesity and osteopororis, particularly the interaction of genetic and environmental factors (exercise, diet) in bone marrow adiposity and the links between adiposity and the properties of bone." (**Harri Suominen**)

4. What single piece of advice would/could you give to policy makers seeking to turn research into policy and practice in your field?

"It's important that policy and practice are evidence-based. Often in the fields of physical activity promotion and obesity prevention, it's tempting to develop strategies on the basis that they seem intuitive or 'common sense', particularly when empirical evidence is sometimes slow in coming and confusing or inconsistent. However there are many expert researchers working in these areas who are only too happy to share their expertise and help to translate research evidence into policies/strategies that are empirically-grounded and thus potentially more effective and cost-effective." (**Kylie Ball**)

"First, in this country, there needs to be a lot more money for research. Without this, we go nowhere. To turn research into policy or practice does demand a degree of purity of the research and, if it is good enough, if the research changes the boundaries sufficiently, then changes should follow. That said, the process, even in the presence of groundbreaking new ideas, can be slow and frustrating, so a degree of perseverance is necessary. It does not hurt to form powerful partnerships wherever possible." (**Simon Bartold**)

"Pay greater attention to supporting individuals who consistently prove their worth, rather than focusing too much on the nature of the project itself." (**Michael Benjamin**).

"In physical activity, the problem is so complex, it needs to be attacked on all fronts. One area for focus is better counselling in clinical settings and schools. We need to take inspiration from things that have worked, such as the impact of infant seats and seat belts on motor vehicle injury and inoculation on diseases in general." (**Steve Blair**)

"There are no single shot magic bullets to change health behaviour so do not expect quick solutions. But results of our behavioural physical activity (and nutrition) research do provide concrete pathways that will help to tackle the obesity epidemic." (**Johannes Brug**)

"My advice to policy-makers is that they should not be misled by claims that physical activity behaviour is entirely personal choice. There is strong scientific evidence that both personal and environmental factors influence physical activity levels in a population. The role of policy in influencing lifestyle is commonly summarised as "make the healthy choice the easy choice" and this approach is appropriate for physical activity." (**David Buchner**)

"I feel that policy-makers need to encourage the increased involvement of healthcare professionals such as sports physical therapists and athletic trainers in children's and youth sports. These healthcare professionals should be on-site and available as often as possible to treat injuries, oversee rehabilitation and timely return to practice, and to offer sport-specific injury prevention programs." (**Dennis Caine**)

"For those interested in the applied aspects of research and theory, we must continually ask the question first posed by the father of modern psychology, William James: *If it doesn't make a difference-- What difference does it make?* By doing so, we can cut through to the critical elements of the issue at hand and package new knowledge in forms that are relevant and understandable, and as such increase the potential for real change." (**David Gallahue**)

"Two things: 1, canvas all stakeholders thoroughly prior to embarking on any research in the first place, and 2, follow through -- particularly with those stakeholders bracketed as 'management' because without their FULL commitment even the best research simply won't get beyond 'publications'. Publications DON"T make a difference: execution of research implications DOES." (**Sandy Gordon**)

"Don't skimp - have faith in the evidence and in those people with a track record in making change; have the courage to support them fully. Don't expect unrealistic short-term results. Oops, I guess that was three things." (**Karim Khan**)

"This is a difficult question but, if I had to name one thing, it would be to make the workplace and schools more nutrition and physical activity friendly. This would help make being active and eating well the 'default' instead of the exception in peoples' lives from their youngest years." (**Melinda Manore**)

"No politics -- just facts and functional understanding." (**Benno Nigg**)

"Make physical education mandatory in grades K-12." (**Claudio Nigg**)

"Not is all as it seems." (**Craig Payne**)

"Investment into sustainable community-based lifestyle interventions for chronic disease is the way to go. In addition to providing greater access to individual and group secondary prevention services for individuals, these programs will also provide greater awareness in the community, improve competition in the marketplace, raise industry standards and provide infrastructure and resources to support other public health campaigns." (**Daryl Sadgrove**)

"The policy makers should trust and turn into policy and practise the encouraging findings of the researchers in that exercise, even if moderate in nature and commenced at an advanced age, may significantly contribute to healthy and active life among the ageing population. And beyond that, even recognise the results obtained in master athletes, which offer a "barometer of possible", i.e. what elderly people can still do when they maximize their genetic potential by exercising regularly." (**Harri Suominen**)

More information about the Conference(s) can be found in the centre page section of this edition of Sport Health.

Dealing with the double edged sword of the media

Dr J

This winter is the first time for seven years that I won't be the doctor for the NSW State of Origin rugby league team. You hopefully get to reflect after every year of doing a job but at the end of a lengthy stint with a team it is a particularly good time for self-appraisal. Elsewhere in this edition of *Sport Health* there is an analysis of the medical management of NSW Origin players over seven years. Some readers may find the raw stats a bit dry, but injury epidemiology is one of my interests. Although there are not too many comparisons available, I'm satisfied with the low (enough) rate of players breaking down when taking injuries into the matches. From a political viewpoint, this is even more important at representative level, as clubs are understandably filthy when a player exacerbates an existing problem during a non-club game. The potential for this to annoy clubs can't be understated when you consider that it is the major reason why State of Origin was shelved in the AFL.

Over the seven years, the one injury exacerbation in the NSW team that particularly upset the club involved was a player who suffered a pneumothorax in an Origin match after taking a rib cartilage injury into the game. While I can completely understand why the club was very disappointed, in terms of severity of this injury before the game, it was definitely on the milder end of the spectrum. There was never any suggestion from anyone beforehand that he wasn't fit to play. I've overseen dozens of players with worse rib injuries get through Origin, finals and regular club games (some with the aid of local anaesthetic and some without) who haven't picked up a pneumothorax. However, in this unlucky situation, the player copped an accidental swinging boot to his chest wall which was already slightly injured. It goes to show that every time you let a player take an injury into a game, you take a risk. At your own club, where you are letting players take risks on a weekly basis, the management is most likely to forgive the occasional recurrence in return for getting many of its players back early from injury. In rugby league State of Origin games, the players are even more desperate to play than at club level, but the clubs themselves are never going to be forgiving about injury recurrences. Hence the high pressure of being a regular football club doctor cranks up a notch further when you get to Origin level.

Another issue worth reflecting on from Origin was commenting on injuries to the media, as it was a constant challenge to not be implicated in any media story with the potential to upset someone. In an Origin camp, there is a continuous scrum of journalists in the hotel lobby (which usually only disperses at about 4am each night when the last of them is refused bar service). Basically they are all expected to come up with one story each, per day, and on slow days injuries are a good staple to fall back on. It is an interesting question as to whether it is generally good or bad for team doctors to make comments to the media.

If you look around the country, there are many long-standing team doctors with distinguished service to their teams who hardly ever get quoted in the press, such as Bruce Reid, Peter Friis, Trefor James and Rod Moore. Harry Unglik worked for North Melbourne for many years and virtually never spoke to journalists. At one medical meeting he explained that this policy was due to being badly burned early in his career when he answered a question strictly off-the-record that became a newspaper headline the next day. I've also heard of a saying that talking to journalists is like owning a pet crocodile — it looks pretty cool for a while but in the end you always end up getting bitten. When you think of this advice and the number of experienced heads who generally keep their thoughts to themselves, you can mount an argument that it is a good policy for sports medicos never to talk to journalists.

On the other side of the coin, there are some sports medicos who have managed to develop and maintain a high profile. Even though there is obviously a potential personal benefit in doing this, I would argue that there is also an upside for the profession as a whole. The list of high profile medicos ranges from specialist media doctors (Peter Larkins and Peter Brukner in Melbourne) to team doctors (Nathan Gibbs and Martin Raftery in Sydney and John Mayhew from across the Tasman) and even includes surgeons (Merv Cross, David Young, Julian Feller) and physios (Errol Alcott). Does the fact that they maintain a high profile hurt anyone else in the profession?

Legitimate News

I suppose like everything else you shouldn't make generalisations but should look at each piece of potential media publicity in its context. If, say, Andrew Johns has just announced his retirement due to a neck injury and you were one of his doctors who advised him to retire, then it would be bordering on petulant to give a 'no comment' response to a question about this. It is a legitimate news story and an issue that the Newcastle and other fans deserve to be informed about. It is the sort of issue that, in AFL circles, would call for a commentary from a Larkins or a Brukner, but interestingly the beast of the sports media doctor hasn't yet evolved in Sydney or rugby league circles.

What happens in such a circumstance is that the journos will tend to call the doctors from the other rugby league teams also and ask them for any additional comments. If you don't have

any new information to add most of the time, most of us will let the ball pass through to the keeper. The danger is that it's hard to comment accurately on a player when you don't have the full clinical information. However, I'd contend that this sort of issue (Andrew Johns' retirement) is one which you can give a green flag to, in terms of answering a question from a journalist. That is, there is a legitimate news story there which itself dictates the back page headline. Whatever comment you make is not going to be highlighted much, because it doesn't need to be, as the editors already have their headline and the journos are just looking for filler quotes.

The alternate red flag question is one where there is no actual major news issue, but you are being asked for a comment. Your natural inclination here is to think that, because you are being asked a question that has no major context, it might be safe to answer it.

Badly Bitten

I got bitten badly myself last year by a journalist from the *Herald-Sun* in Melbourne who called to ask a question on local anaesthetic use in the AFL. His hook was along the lines of "…we were trying to do some research on the use of local anaesthetic in football players and noticed that there is hardly anything published on the topic, although we've found that you've published a couple of research studies on it. Does it surprise you that hardly anyone else around the world has done any study on local anaesthetic use?" In retrospect, this *may* have been a safe topic to answer if a famous player had just had a femoral nerve block accidentally administered the day before and there was an obvious story brewing. However, the fact that the questions came out of the blue didn't flash enough warning lights for me and I made the mistake of saying words to the effect of "Yes, I am surprised that more research hasn't being done on the topic, as local does get used a fair bit in professional sport and occasionally leads to side effects".

I wouldn't claim to be naïve enough not to think that this sort of comment wouldn't lead to a quote in a newspaper, but I was quite astounded that it was one of the listed quotes which contributed to a front and back page headline in the Herald-Sun *three weeks* after the only conversation I had with the journalist. The headline read something like "AFL: Come clean on jabs", with an introductory sentence of something like "Leading sports medicos have claimed the AFL isn't doing enough research on local anaesthetic use in football".

I've seen similar headlines arise after so-called investigative sports journalists have managed to trap a handful of team doctors into conceding that players at their clubs occasionally use caffeine tablets, for example. Basically the technique is the journo ringing around for a collection of seemingly innocuous quotes (which they all are individually) from a few sports doctors but then using the innocuous quotes to create a story which runs with an inflammatory headline. Local anaesthetic is one of the football journalists "go to" topics in the sports medicine genre, along with caffeine use, Sudafed use, players with hepatitis and HIV, concussion, long-term effects of football on the knee, illicit drug use, safety of playing in the heat, etc, etc.

Soap Opera

One thing that does surprise me as much as the media overreaction to a minor issue is the counter overreaction of everyone else in the football industry to the initial overreaction. We live in a media climate where they blow almost everything out of proportion, so it shouldn't be surprising next time it happens, should it? It seems to be part of the ongoing soap opera that one rule of being a sports administrator is that you can't laugh off a media beat up, but instead you need to put your most serious face on and appear to be furiously getting to the bottom of the problem.

Although we think it is tough sometimes working in sports medicine, imagine being the media officer for a football organisation: your mission statement is that "we want you to maximise the amount of exposure our organisation gets in all forms of the media but, in doing so, make absolutely sure that you avoid all controversial issues". The only problem being, of course, that the media are generally completely uninterested in any issues which aren't controversial, reflecting the wishes of the viewing public. Despite the pressure of working in a high profile sport, those in the football industries must constantly remind themselves that the number one reason why they get paid far more than someone working in an identical job in, say, netball, is because of the media interest in the game.

An unforgettable and quite surreal experience from my time in State of Origin was being in camp when the famous 'Mark Gasnier mobile phone message' story broke a few years ago. This story blew up like a volcano over a number of days with some key juicy elements: sexual harassment of a girl, but one who had a nightclub history; a superstar player who was too good to throw out of the game; his mates covering up for him; the voice message mysteriously finding itself at the office of (perhaps) the highest bidder. The entire week seemed like Groundhog Day with some 70 year-old woman continually calling Ray Hadley on 2GB saying: "Ray, I was trying to listen before when you played that absolutely disgusting message that that awful player left on that poor girl's message bank, but my hearing isn't too good. Do you mind playing it again for me so I can just check that it was really as disgusting as I thought it was?"

Reality Check

Our coach that year, at a press conference, described the mood of the Origin camp as being "about on a par with the Holocaust". This of course drew more outraged complaints from Jewish members of the public, furious that the Holocaust was being trivialised. There was one phone message that was revealed privately to the rest of the staff late in the week that was about the only reality check we got for the whole camp. It was from the Channel Nine CEO at time, calling the coach from a meeting in the USA, saying words to the effect of "Well done, it was looking like it was going to be a boring Origin series this year with low TV ratings, but I knew you and the boys would come up with something to spice it up".

Pathomechanics of lower back injuries in junior and senior fast bowlers: a prospective study

Marc R Portus, Howard Galloway, Bruce C Elliott and David Lloyd

The relationship between lower back injuries and fast bowling technique has been researched for approximately 20 years. The evolution of equipment available to sports biomechanics researchers now means the full three-dimensional kinematics of the trunk can be measured. Previously fast bowling research has used 2D or planar methods when prospectively assessing the link between the fast bowling action and injury. This research has provided the basis for the link between the 'mixed' technique - the predominant feature being a large shoulder counter-rotation of the upper trunk in the transverse plane – and lower back injuries. The present study used a three-dimensional inter-segment trunk model and prospectively tracked a junior and senior cohort through a cricket season to assess further the pathomechanics of lower back injuries.

Methods

Sixty-eight fast bowlers attended the Australian Institute of Sport in Canberra over a one month period early in the 2002-03 cricket season. Forty-four of these were junior bowlers and played competitive age-level cricket in Sydney and Canberra (mean age 15.1 ± 1.3 years). Twenty-four bowlers formed a senior cohort (mean age 23.6 ± 3.4 years) who were professional cricketers from the state cricket associations of Victoria, New South Wales and Queensland.

Each bowler delivered 18 deliveries at match pace in the AIS Biomechanics Laboratory, which permitted full length run-ups and had a synthetic grass cricket pitch. Bowling technique was analysed using an 8-camera Vicon Motion Analysis System (120 Hz) and a Kistler force plate (1060 Hz) to record impact forces during the front foot contact phase. A hierarchical trial selection model was used to analyse three to six deliveries per bowler. The premise of this was to analyse the deliveries that were characterised by higher relative ball speeds and accuracy scores to improve the ecological validity of laboratory testing. Pelvis, lumbar (lumbar rig), thorax and shoulder kinematics were measured in the flexion-extension, lateral flexion and rotation axes using a Bodybuilder for Biomechanics (Oxford Metrics, UK) custom written kinematic model. Bowlers were tracked through the season and were grouped by the type of lower back injury that caused them to miss at least one match after clinical and radiological diagnoses. These groups were: Group 1 = Bony Stress Injury; Group 2 = Soft Tissue Injury; Group 3 = No Lower Back Injury. Statistical differences between injury status groups within each cohort were assessed by analysis of variance.

Results

The junior lumbar bony stress injured bowlers exhibited higher levels of axial counter-rotation throughout all trunk segments (pelvis, lumbar, thorax, shoulder) than junior non-injured bowlers. The range and velocity of counter-rotation of the pelvis and lumbar segments in particular were significantly higher in the junior bony stress injured bowlers ($p = 0.01$). Statistically, juniors using excessive levels of trunk counter-rotation had a 5.6 times greater relative risk of lumbar bony stress injury. Conversely, for the senior bowlers, there were no axial trunk rotation (counter or forward) variables that were higher for back-injured bowlers. Rather, the senior back-injured group displayed patterns of increased trunk lateral flexion between back and front foot impact ($p = 0.13$), as well as a more laterally flexed lumbar segment at the instant of front foot impact and peak vertical ground reaction force ($p = 0.26$). The technique factor that significantly differentiated senior lumbar bony stress injured bowlers was the range and velocity of pelvic obliquity in the phase from front foot impact to ball release ($p = 0.02$). Peak vertical ground reaction forces were also experienced at the commencement of this phase.

Conclusion

These results indicate that age, growth and physical maturation are likely to be important factors to consider when assessing potential pathomechanics in a fast bowlers technique. Adolescent fast bowlers in this research were more susceptible to "breaking down" when using higher ranges and rates of trunk counter-rotation (ie, the 'mixed' technique). In contrast the senior bowlers seemed to be more resilient to the increased spinal torsion of the mixed technique (similar magnitudes were recorded to juniors). Seniors were, however, more likely to suffer lower back injuries when higher ranges and rates of lumbo-pelvic motion in the lateral flexion axis were recorded. Age-specific technique coaching, workload management and physical conditioning programs for fast bowling would appear to be important implications from these findings.

Acknowledgements

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Conventional, reverse and contrast swing bowling

Rabindra D. Mehta*

So how many swing types are there in cricket and, as some cricketers argue, does it really matter what you call a particular type of swing? Well, it matters because the science dictates what type of swing it is. Of course, cricket bowlers do not have to know or understand the science, but it sure would be nice to know when a certain type of swing will be effective and in which direction the ball is likely to swing. I sure wish I knew half of what I know now when I hurled that cricket ball down the pitch at more than 'fair' speed in the 70s.

Aficionados know cricket as a game of infinite subtlety, not only in strategy and tactics but also in its most basic mechanics. On each delivery, the ball can have a different trajectory, varied by changing the pace, length, line or, most subtly of all, by swinging the ball through the air so that it drifts sideways. Such movement has always fascinated cricket fans, but seldom do they understand the underlying mechanisms that cause the cricket ball to swing. In fact, more often than not, they have to rely on myth and folklore readily and eagerly spread by the media, rather than the basic principles of science.

The actual construction of a cricket ball and the principle by which fast bowlers swing the ball is unique to cricket. A cricket ball has six rows of prominent stitching along its equator, which makes up the 'primary' seam. The better quality cricket balls used in competitive cricket are, in fact, made out of four pieces of leather, so that each hemisphere has a line of internal stitching forming the 'quarter' seam. The two quarter seams are traditionally set at right angles to each other. These primary and quarter seams play a critical role in the aerodynamics of a swinging cricket ball. It is believed that this type of swing originated around the turn of the century, but there is evidence that it was in existence well before that time.

The basic aerodynamic principles responsible for conventional swing of a cricket ball were identified decades ago and many papers have been published on the subject. For conventional swing, the ball is delivered with the seam angled towards second slip or leg slip and the ball swings in the same direction as the seam is pointing. A shiny, smooth surface facing the batsman helps in achieving conventional swing. Over the last 25 years or so, several empirical investigations have also been conducted on cricket ball swing, which revealed the amount of attainable swing and identified the parameters that affect it.

I first heard about the ball swinging the wrong way in the summer of 1980. This phenomenon soon became known as 'reverse swing' and took the cricket world by storm. For reverse swing, the ball is released in the same way as for conventional swing, but it swings in a direction that is opposed or reversed to that of the seam. For reverse swing, it helps to have a rough side facing the batsman. The ability to swing the ball in a reversed direction while maintaining the same grip, bowling action and bowling speed is what makes reverse swing so attractive and effective. Of course, another reason why reverse swing has gained such notoriety is its constant link to accusations of ball tampering.

On a visit to the ECB National Cricket Academy in England in December 2005, I realised that there was still some confusion regarding the true definition of reverse swing. They had a practice session devoted to reverse swing using balls with one side deliberately roughened. Some of the bowlers swung the ball quite well, and they thought in the reverse sense. However, the ball generally had the seam straight up (not angled) and it swung towards the smooth side. This was obviously not conventional or reverse swing and so I developed the new term: 'contrast swing'. So how is contrast swing different from conventional and reverse swing? For one thing, the swing direction is determined by the bowling speed, as opposed to seam and smooth/rough surface orientations. The most exciting feature about contrast swing is that just about any bowler (regardless of bowling speed) can implement it in practice and the ball will swing even if the seam is completely 'bashed-in'. As most cricketers are aware, it is much easier to release the ball with the seam straight up, rather than angled towards the slips or fine leg. Thus, even mere mortals should be able to swing such a ball, and in either direction, since the bowling action is the same for both swing directions.

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Australian Institute of Sport. The athletes, Patrick Farhart, Rebecca Dennis, John Orchard, Tom Cross, Kevin Osborne, Leanne Monte, Steve Mullaly and Steve Dowlan deserve special mention.

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The how and why of sporting expertise

Implications from the study of experts to skill acquisition in cricket

Bruce Abernethy

Expertise in cricket is not easily acquired. Consequently, finding means to accelerate the acquisition of expertise through improved training methods or enhanced identification and support of talented performers is fundamental to a successful sports system. The systematic study of sports expertise can assist with identifying the essential attributes of exceptional performers, in determining the unique ways in which experts differ from non-experts and in providing guidance as to what factors should be given emphasis in talent identification and development. Recent research is informative as to the limiting factors to batting expertise, the use of different information ('cues') by batsmen of different skill levels and the developmental factors known to be associated with the emergence of cricketing skill.

Comparisons between experts and non-experts on tests of different sub-components of batting skill provide a means of determining what factors likely do, and do not, limit performance. Experts consistently outperform non-experts in such sub-skills as pattern recognition, anticipation and the concurrent performance of multiple tasks. Experts, for instance, are adept at anticipating the intention of a bowler from advance vision of their pre-release movement patterns (Abernethy & Russell, 1984) and this may explain the expert's ability to provide the impression of having 'all the time in the world' to execute their strokes. Experts show little or no differences from non-experts on general functional tests of vision, cognition or motor ability with even visual acuity being able to be degraded dramatically without any major impact on batting performance (Mann et al, in press). It is more sensible for coaches to devote practice time with non-elite players to the enhancement of skill components, like anticipation, that are clearly essential for expert performance, than to the enhancement of basic attributes, such as visual acuity, that do not need to be at supra-normal levels to support expert performance.

One of the main reasons experts outperform non-experts on skills like anticipation is that they attend to different cues and pick-up information from different features of their opponent' actions. Studies selectively occluding potential cues for anticipation indicate that experts have a unique ability to pick-up information from the isolated motion of the bowling hand and arm that assists in the early identification of the type of ball that has been bowled (Müller et al, 2006) plus experts show a greater ability to use early ball flight cues to aid successful bat-ball interception (Müller & Abernethy, 2006). Different eye movement strategies may also distinguish better players from novices (Land & McLeod, 2000), although additional experimental confirmation of the visual search patterns of cricket batsmen of different skill is required. Knowing the differences in information usage between players of different skill level can help determine what must be learned in order to become an expert but this does not, in itself, help ensure an accelerated rate of skill learning for non-experts. Simply drawing non-experts' attention to the sources of information used by experts is unlikely to be effective as a form of training unless there is some parallel means of providing the experiential base to ensure the 'meaning' of the information available from particular cues is understood. Further, explicitly drawing the attention of non-experts to particular cues used by experts may be counter-productive given that the experts' use of such information is frequently below the level of consciousness and largely immune to interference from stress and other consciously-mediated effects. A major focus of current research is therefore to find more implicit practice methods that can facilitate the learning of expert-like skills without the impediments known to be associated with conscious control.

Understanding more about *who* become experts and *what* conditions are necessary to support and promote their skill learning is fundamental to improving the developmental pathways for promoting the emergence of exceptional performers. It is now well established that an individual's early experiences can have a powerful and enduring influence on the likelihood of eventually becoming an expert. Being relatively older in entering junior sport teams, growing up in rural and small towns rather than large cities, having a broad range of experience in different sports before specialising, experiencing early exposure to playing against adults and having access to environments that permit large amounts of unstructured practice and play, all appear to be conditions that are favourable to the development of expert ball-sport players (Abernethy & Farrow, 2005). For sports, like cricket, with an historically diverse talent base, reflecting on these critical developmental experiences of current expert players may provide important leads as to the essential characteristics that need to be retained within the junior sports systems and developmental pathways for the next generations of potential experts.

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Why do fast bowlers bowl no-balls?

"It's bloody laziness, lad" and other explanations!

Ian Renshaw and Keith Davids

Despite the fundamental importance of the run-up to successful performance in fast bowling, few studies have examined how bowlers regulate footfall placements during approach runs. The traditional understanding of strategies in the cricket run-up is that repetitious practice over time can lead to the standardisation of a movement pattern, leading to the view that no-balls are caused by lazy inattention of bowlers to legal foot placements when practising. In this article we discuss findings from a series of studies aiming to enhance our understanding of how the run-up is regulated during bowling.

In three studies completed so far, the run-ups of medium-fast bowlers were filmed using a panned video camera (operating at 50 Hz) elevated perpendicular to run-up direction. Heel to popping crease distances for each foot placement were determined and subsequently data were analysed in Excel 2000. Traditional group analyses (eg, means and deviations) individual analysis of each run-up using methods pioneered by Montagne et al (2000) were conducted.

Data from the initial group analysis of run-ups of UK professional cricket bowlers when umpires were present revealed some surprising findings. First we noted that, despite the high level of inconsistency displayed by the bowlers in the starting position of the run-up (range 0.20 m to 0.97 m), all bowlers achieved low levels of inter-trial variability at the bound footfall (0.08 m to 0.16 m). Analysis of step length adjustments during the run-up revealed that bowlers appear to regulate their steps as needed throughout the whole of the run-up. More specifically, although there were some individual differences, typically, bowlers regulated steps very early and very late in their run-ups. In a follow-up study, the same bowlers bowled when no umpire was present. Although bound footfall variability was generally similar to conditions when the umpire was present, absence of umpires led bowlers to adopt very different run-up patterns to those observed when umpires were present. In a third (case) study, we required one bowler to bowl with (i) umpire present, (ii) no umpire present and (iii) no stumps and umpire present. Results showed that the absence of umpire and stumps led to the bowler being much more precise in placing his foot near his check mark than when the umpire was present. Interestingly, although inter-trial variability within each condition was similar at the front foot landing position (0.08 m, 0.08 m and 0.04 m), the mean distance of the final footfall placement was progressively closer to the popping crease as more information was removed from the environment (umpire present = 0.35 m; absent = 0.21 m no umpire or stumps = 0.04 m). This finding illustrated how bowlers adjust movement patterns according to information available in the environment.

Our findings have enabled us to begin to understand how bowlers control their run-ups and to provide coaches and bowlers with some basic information to underpin the practising of run-ups. First, coaches need to understand that repetitious practice does not lead to memorisation of standardised motor patterns in cricket run-ups. Rather, the individual patterns of step length adjustment observed in our studies suggest that individual constraints such as run-up speed and bowling style impact on movement production. The data imply that bowlers need to visually regulate the run-up instantaneously (in a subconscious way) early and late in the run-up rather than focus on 'standardisng the non-standardisable'.

Second, it seems that the inconsistent start points do not lead to high levels of variability at the end of the run-up. Clearly, no-balls are not due to laziness in adhering to consistent starting locations. However, before advising bowlers to throw away their markers, we suggest that it is likely that the marker is important in developing some consistency in the number of steps used in the run-up.

Third, bowlers should always practise in conditions that closely replicate match conditions. The early visual regulation strategy displayed by the professional bowlers in our study implies that it makes sense for bowlers to practise with umpires and stumps present, since this strategy will 'educate the attention' of experienced and inexperienced bowlers in identifying key information sources with which to couple footfall placements.

Further research is needed to build on these preliminary findings by studying bowlers' intentions, differences due to expertise and intra-individual differences in run-ups when no-ball and legal deliveries are bowled. In this way we intend to provide a comprehensive understanding of run-ups that can enable coaches to effectively improve bowlers' run-ups and where necessary solve persistent no-ball problems.

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Adolescent fracture implications related to growth

DA Bailey, CM Engstrom and DG Walker

Fractures are common in childhood and adolescence; approximately one-third of boys and girls sustain at least one fracture before the age of 17. While the fracture rate is higher in boys than in girls, the peak incidence occurs about two years earlier in girls and in both sexes is associated with the timing of the adolescent growth spurt (Bailey et al, 1989). In terms of adolescent athletes, stress fractures are common overuse injuries associated with repetitive loading of both the appendicular and axial skeleton. Symptomatic stress lesions of the lumbar spine are clinically significant injuries in adolescent athletes engaged in activities involving repeated, forceful hyperextension and axial rotation of the thoracolumbar spine such as gymnasts and cricket fast bowlers.

To investigate bone strength and bone mineral accretion in growing children, the Saskatchewan Pediatric Bone Mineral Accrual Study was initiated in 1991. The longitudinal study involved the collection of anthropometric growth and maturity measurements taken every six months and DXA scans of the total body, lumbar spine and proximal femur taken annually. Subjects were followed from 1991 to 1997 and again as adults from 2002 to 2006. Of the original sample of 228 subjects (113 boys and 115 girls), 145 have been retested during the young adult years.

To control for maturational differences between boys and girls of the same chronological age, we determined the age of peak linear growth (PHV) for each individual subject. This gave us a common maturational landmark (equivalent to 92% of adult height) which was used as the baseline for comparisons between boys and girls. Bone mineral and structural bone strength values were determined at points representing ages 3, 2, 1 years on either side of PHV. Using this approach the following findings would appear to have some relevance in terms of adolescent fracture incidence.

During the adolescent years there is a dissociation between linear growth and bone mineral accrual. Peak linear growth precedes peak total body bone mineral accrual by over eight months in boys and 11 months in girls. This lag time between linear growth and bone mineral acquisition has clinical significance. Adolescent fracture incidence is at a peak during this period (Bailey et al, 2003).

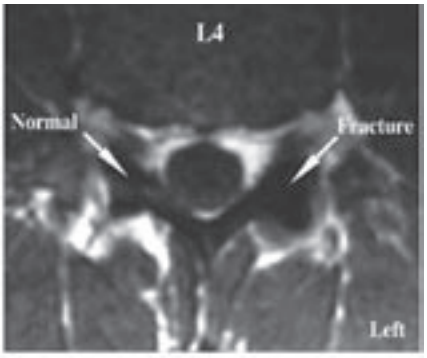
Consistent with the above observation, when corrected for size, apparent bone mineral density actually shows a drop during the adolescent growth spurt period (Faulkner et al, 2006).

The adolescent growth spurt is a critical time fo r bone mineral accretion. Weight-bearing physical activity is a modifiable determinant of bone mineral accrual during the growing years. We have demonstrated that the growing skeleton responds to increased everyday physical activity by increasing the accumulation of bone mineral (Bailey et al, 1999). However, at very high levels of intensity,veruse injuries have the potential to produce stress fractures in adolescent athletes, particularly in sports involving repetitive, forceful loading of the immature skeleton.

A 4-year prospective MRI study was conducted to investigate isthmic-type lesions of the pars interarticularis in the lumbar spine of fast bowlers (N=51) and swimmers (N=20) aged between 13 and 17 years (Engstrom & Walker, 2007). Annual MRI examinations in the bowlers (4 yrs) and swimmers (2 yrs) consisted of thin sagittal and axial (parallel to the L4/5 disc space) images to optimise visualisation of the individual pars.

Overall, *symptomatic* L4 and L5 pars interarticularis lesions developed in 22% and 1% of the adolescent fast bowlers respectively. Clinically, the development of these neural arch lesions in the caudal

Figure 1. A unilateral L4 pars stress fracture (axial MRI) in a right arm bowler.



lumbar vertebrae was characterised by an insidious onset of low back pain directly related to fast bowling. All the symptomatic L4 pars lesions in the fast bowlers developed between 15 to 17 years of age and were all unilateral stress fractures lateralised to the non-bowling arm-side (Figure 1). In addition, pre-existing *asymptomatic* L5 pars lesions were observed in 20% of the adolescent fast bowlers with the majority (73%) of these cases being bilateral non-united (chronic) defects. In the swimmers, there were no lesions at the L4 vertebral level although 20% of these "control" athletes had pre-existing *asymptomatic* L5 pars defects.

It is tempting to speculate that there is a differential timing with regard to the development of the 'cricket-specific' L4 unilateral stress fractures and the more 'generic' L5 pars defects with the majority of the L5 lesions occurring at a younger age (potentially pre-PHV) while the L4 fractures in the current cohort of bowlers likely occurred post-PHV. Furthermore, it seems likely that the injury mechanism/s underlying the L4 and L5 pars lesions may be different with a 'cricket specific' unilateral loading of the lumbar spine during repetitive axial rotation and/or lateral flexion associated with the development of the L4 pars lesions on the non-bowling arm side (Engstrom

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Evidence from baseball that umpiring decisions are influenced by game context

Clare MacMahon

Traditional approaches in sport decision-making research test problems with a 'correct' and agreed upon answer. In many cases, however, the most critical decisions are often the least clear-cut. This is particularly the case for officiating decisions. The approach used in this study was to examine borderline or ambiguous decisions for the ball-strike judgment in baseball.

When an individual batter faces a pitcher and does not hit the ball, the plate umpire must judge the flight path of the ball relative to the strike zone. If a pitcher throws four balls, the batter is 'walked' to first base, with the opportunity eventually to score. If a pitcher throws three strikes, the batter is retired for an 'out'. Three outs end an inning, diminishing the batting team's opportunity for points. The pitch count, which tallies the number of balls and strikes during an individual batter's 'at bat', is thus an important piece of contextual information, showing whether or not the pitcher or batter is ahead, and how critical the situation is.

Baseball pitches were filmed from the umpire's perspective using a helmet-mounted camera. Pitch clips were viewed by three expert baseball umpires who classified them as 'balls' or 'strikes'. This resulted in a pool of definite 'ball' clips, and a pool of definite 'strike' clips where the three experts agreed. Disagreements between the experts were used to identify ambiguous or borderline pitches.

We recruited 31 baseball umpires, 16 baseball players and 27 control participants with little to no baseball experience to complete three tasks. The basic task was to watch a clip and classify it as a ball or a strike. Participants were then asked to rate their certainty on a scale from 1 to 5, where a 1 was definite and 5 was borderline. Post data collection, balls were designated -1 and strikes +1. When the two components of the decision were combined, responses ranged from 'definite ball' at -5 to 'definite strike' at +5.

In a basic judgment task, participants viewed 32 video clips of definite balls and definite strikes. In a 'direct information task', participants made a ball-strike decision for the same 16 borderline pitches presented in four different conditions: 1, following one definite strike; 2, following two definite strikes; 3, following one definite ball; and 4, following two definite balls. All borderline clips were seen in each condition.

In the 'summary information' or 'pitch count task', participants were shown 12 borderline pitches in four different pitch count conditions: 1, a neutral count of 0 balls and 0 strikes; 2, a 'batter-ahead' count of 3 balls and 0 strikes; 3, a neutral but critical count of 3 balls and 2 strikes (where a ball decision leads to a walk to first base and a strike decision leads to an out); and 4, a 'pitcher-ahead' count with 0 balls and 2 strikes.

Umpires and players were significantly better at calling pitches than controls in the basic judgment task, and thus it is a task that taps into experience-based expertise. In the 'direct information task', all participants called target clips closer to the strike end of the scale when viewed after definite balls than when they followed definite strikes. Similarly, in the 'pitch count task', participants called pitches more towards the strike end of the scale when there were three balls in the count (3-0, 3-2), then in the other two pitch counts (0-0, 0-2). A final interesting finding is that, compared to the players and control participants, umpires showed a greater overall tendency to call strikes as opposed to balls.

These findings provide evidence that the standard for evaluation of a baseball pitch changes based on the context. Moreover, previous pitches (ie, definite strikes, definite balls) and the pitch count appear to be strong contextual factors, given that their influence is shown not only in umpires and players but also in participants with little experience with the sport. The results of this study also provide evidence that umpires use a normative rule of 'hastening the game', or moving it along by calling strikes (Larsen & Rainey, 1991).

This work not only shows that context influences decisions but also provides a useful approach to understanding the complexity of critical decisions in a variety of sports. Specifically, these results allude to further work in cricket umpiring to study decisions and potentially design interventions to improve decision making. For example, this method can be used to examine critical difficult decisions such as wides, no balls, outs and LBWs. Contextual factors such as the score, stage in the match and status or ranking of a player and strength of an appeal may all influence decisions. Studying these factors is the next step in this area of research.

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SMA(ACT) Injury reporting trial

Results and analysis

John Lockie and Patricia Donoghue

Largely because of the impracticality of available reporting forms, injury record-keeping by trainers in the Australian Capital Territory is sparse. So we developed an injury recording methodology better suited to the environment in which trainers work and, with the support of the ACT branch of SMA, tested. As a by-product of the methodology, a source of statistical data emerged that could be useful in estimating the full extent of sporting injuries across a region.

Why we needed to do something

The need for injury reporting is well accepted, but often more from habit than from a considered need to collect information for specific purposes. The lack of obvious purpose, combined with the impracticality of the available recording forms, has meant that record-keeping by trainers, from our observation, is usually at best sketchy, at worst non-existent.

There are three major applications for injury and treatment data, each requiring significantly different detail:

- epidemiological studies to yield trends, which may in turn suggest or support injury prevention strategies;
- personal injury records of athletes, to help them and their medical professionals provide on-going treatment; and
- records of treatment for the treating practitioner in case the treatment is questioned at some stage in the future.

In the core business of a trainer (injury prevention and immediate management), the major reason is the last of these: what was done, and to whom. Data for other applications can be derived from this, or got in other ways as a separate exercise, albeit at some extra cost. Data collection for other applications certainly contributes to the overall goals of athlete care and injury prevention, and is a legitimate component of a trainer's role, but it is not the core business.

For first aid coverage supplied to external clients, SMA(ACT) has used a number of different injury reporting forms, most of which were designed for something else. They may have been suitable for their original purpose, but all have critically serious failings when applied to recording coverage. For the purpose of recording what the trainer has done for each athlete, the forms seek irrelevant data, are large, unwieldy, unnecessarily complex and difficult to complete outdoors.

The key point is that trainers can't be assumed to work in a clinical environment (air-conditioned room, one patient at a time, don't see the next until you are finished with this one, etc). They are far more likely to be in medias res – in the middle of it all; in a crowded dressing room or on a muddy playing field, surrounded by a confusion of athletes who are focused on getting on with their sport. So record-keeping needs to be quick and intuitive, or it won't happen.

Where trainers are simply ordered to supply data in an impractical way, with the best will in the world, there is significant risk of a low correlation between the data supplied and reality.

What was needed was an injury recording methodology that was practical in a trainer's environment and would capture data essential to the trainer and the trainer's employer.

Figure 1 - Sports Medicine Australia Treatment Log

DATE: 1 Apr 2004 TRAINER: John Page: 1 of 1 EVENT: School AFL
VENUE: Stirling Oval EVENT DIRECTOR: Bill Smith ph: 0416 123 456

TIME	PLAYER ID	ASSESSED CONDITION	TREATMENT including advice to seek professional help if condition has not improved within 24 hrs
1030	Heather - Fraser Primary	Minor sprain R ankle	RICE, advise teacher no RTP today
1120	Fred Smith – Yass HS	Head clash, possible mild concussion	Advised manager: rest and no RTP, gave Fred head injury sheet to give to parents
1125	Bill – Kaleen PS	Graze L knee	Dressed
1140	Yass HS #27	Blister R thumb	Dressed
1210	1030	Played again, R ankle worse	RICE, lecture NO RTP, strongly advise see physio ASP
1230	Sue – Dickson College	Pain L shin	Ice, plantar fascia taping, RTP within limits of pain
1315	Fred – Casey HS #12	Fall on R hand, ? frac R radius	Ice and support, to Calcary A&E by car with Mum

What we did

1. Design a more practical methodology

Despite the inadequacies of the 'official' injury report forms, many experienced trainers do keep some form of record, but in their own way. So these informal techniques were brought together with the specific needs of coverage recording, in an attempt to produce a succinct, useable, standard recording instrument.

Some of the issues considered included:

What data to collect
Much of the information sought in all the existing forms is irrelevant to coverage reporting; the sex of the athlete, their date of birth, whether they were a player or official, just to mention a few examples. As well as being unnecessary, some of these are of a sensitive or invasive nature. All the information that was considered necessary in regard to a treatment was:

- date/time and place
- a way of identifying the athlete
- assessment of injury/injuries
- treatment given
- advice given, and to whom.

Reporting form: menu or free-form
It was assumed that trainers are competent and so will follow protocols (such as TOTAPS), can name body parts and describe injuries. Hence the bulky 'menu' style of the existing forms (which causes each to occupy at least an A4 page) was considered unnecessary, because it would be quicker to write a few words than scan long menus and tick boxes. It was accepted that this would mean additional work if the data were to be later encoded for analysis.

Re-presentations
Another drawback of existing forms is that they assume that the athlete will not return once initially treated; if they do, another form is required. In practice, athletes often re-present, for re-assessment once swelling has subsided for example. The reporting form needs to be able to follow an athlete at least until the end of a day.

Figure 2 - Sports Medicine Australia Event Coverage Injury Summary

DATE: 1 Apr 04 TIMES: 1200 - 1600 VENUE: Griffith Oval EVENT: High School rugby
EVENT DIRECTOR: Bill Smith TRAINER(S: John L

NOTE – These are the injuries that presented to the First Aid Centre or were treated on field by the Trainer; they are NOT necessarily the total for the event.

Immediate referral to medical professional Immediate return to play possible after treatment

	Minor	Less Severe	Severe
Laceration/cut/abrasion	III	I	
Bruise/cork	III	II	
Strain/sprain/overuse/tracking	IIIII III	III	
Fracture/dislocation/subluxation (including suspected)		II	I
Concussion/superficial head/spinal (including suspected)		II	
Environmental causes (eg heat stress)	II		
Medical condition		I	
Other (eg winded, cramp, blisters, splinters etc)	III		
Misc – athlete not assessed (eg. general advice, give out ice, bandaids etc)	IIIII IIIII II		
TOTALS			

Privacy
Collecting data about people, particularly medical-related data, must very much comply with privacy laws. A general theme of most such laws is that information should only be collected where there is an agreed legitimate need. There were also considerations of duration and security of storage, confidentiality and so on.

What constitutes a significant injury, worth reporting
Most injuries treated during coverage are minor, the treatment routine, and seldom seem worth reporting; the more so if it takes longer to do the reporting than do the treating. However, even the most apparently trivial injury might turn out not to be so. So the expectation is that some record will be made of any injury where the trainer does an assessment, even if no treatment is given.

Duty of care
While it remains a matter for legal clarification, there may be a difference between the duty of care owed by a trainer doing what is essentially first aid and that owed by a fee-for-service clinician to a patient. This difference could affect the level of recording necessary to constitute a 'reasonable' record of events.

Statistics
When trainers do coverage for a client, a component of recording what they have done for athletes is to generate for the client a profile of the trainers' activity during the event. This requires the collection of some statistics. But, consistent with our goals, this also needs to be done quickly and in a format that is practical in a trainer's environment.

The result was a methodology involving three levels of reporting:

A Treatment Log (Fig 1) to record all assessments and treatments other than the most trivial. This is completed as soon as possible after treating someone (ideally immediately) and remains the property of the trainer. It is the trainer's responsibility to keep the log for a reasonable period of time (12 months is currently suggested) in case details of treatments are required in the future.

A Statistical Summary (Fig. 2) covering various types of injury and grades of severity. (With a 'minor' injury, the athlete can return to play immediately following treatment; a 'severe' injury requires immediate presentation to a hospital accident and emergency department (A&E); 'less severe' is somewhere in between.) This is completed as a rough copy by putting

ticks in the appropriate boxes during the event. After the event, the trainer makes a fair copy, by turning the ticks into numbers, and submits it to SMA(ACT) with the invoice for the event.

An Incident Report (Fig. 3) for any significant incident which, in the judgment of the trainer, may give rise to claims against either the client or SMA. All ambulance calls are in this category. Reports are completed after an event with details from the treatment log and are submitted to SMA with the invoice for the event. If the trainer is unsure if an incident is worth reporting, at the very least the treatment log must have sufficient detail to generate one later if asked.

2. Trial it

The Board of SMA(ACT) and National Office agreed to a trial using the methodology for all coverage undertaken over the five-month period between November 2004 and March 2005. The aim of the trial was to measure the practicality and cost of using the methodology and to see to what extent the data collected met the needs of trainers, SMA, coverage clients and any others with a general interest in sports injury data.

Some 49 different events (over 800 coverage hours), representing 12 different sports, were covered by 17 trainers (some of whom covered more than one event). The trial was evaluated, using questionnaires to trainers and clients, interviews with SMA(ACT) staff and feedback from the SMA(ACT) committee.

In summary, results from the trial were:

- From the trainers' responses, the methodology allowed the majority of injuries to be recorded immediately after treatment. This gives some sense of confidence in terms of relative completeness and accuracy of recording, with little reliance on memory.
- There was strong preference for the trial methodology over current forms which, if anecdotal evidence is to be believed, are seldom, if ever, used.
- Even though no direct benefit comes back to the trainer from recording statistics, there appeared to be a strong belief among trainers that reporting injury trends is worthwhile, provided it does not detract unduly from their 'core business'.
- Event organisers appeared interested in the statistics gathered. Even if this interest is not translated obviously to injury prevention action, at the very least it promotes the profile of injury prevention.
- The Executive Officer, SMA(ACT), estimated that the workload associated with the trial, apart from a few hours of set-up, was an insignificant addition to the other booking and billing tasks associated with event coverage.

So the methodology appears reasonably practical in a Safer Sport environment and trainers are prepared to use it. It offers a standard way to record treatment and provides statistics where currently there are none; and it does this at a minimal cost of both time and money. Hence it appears a major improvement over the forms suggested in the Sports First Aid Manual, Level 1 Trainer Manual and other ad hoc survey forms being used for a purpose other than that for which they were designed.

The SMA(ACT) committee was presented with an interim report on the trial which included a summary of the statistics gathered. The committee concluded that the statistics were useful to the extent that they should continue to be collected.

Figure 3 - Sports Medicine Australia Incident Report

ATHLETE NAME: Sony Tavis
TEAM: Hawker College
PLAYER: #2
DATE: 8/3/04
TIME OF FIRST PRESENTATION: 1130 VENUE: Manuka
TREATED BY: JL

DETAILS OF INJURY
Inversion R ankle, pain 8/10

TREATMENT

1130	Splint and stretcher off
1145	Unable to tolerate ice, pain still 8/10. Called ambulance and parents
1155	Parents arrived and took charge
1200	Ambulance to Canberra Hospital A&E

ADVICE GIVEN (Indicate to whom)

COMMENTS

1500	From Teacher: x-ray confirmed fracture

What could be done next

Sporting injuries can be counted in many ways and there have been innumerable studies focusing on sub-sets of the problem: injuries within a particular sport, or age-group, or event, or whatever.

Of the various estimates of overall sporting injuries in Australia, most seem to focus on severe injuries (ie, those that present to hospital A&E, sports medicine clinics or other medical professionals) and for good reason, because these are the most costly to treat and the sources keep formal records which can be accessed for counting purposes.

But these are only the injuries that are serious enough to warrant professional attention, and probably represent only a small proportion of all injuries across all levels of sport and recreation. Non-referred injuries may cost less to treat but, multiplied by their probable

frequency, they would be a major national cost and disincentive to participation. Where participation in activities is being promoted as a health benefit, they could be an important factor in identifying the net benefit of exercise. (Is it cheaper to treat sprained ankles now than deal with obesity-related conditions in 10 years time?)

Reliably recording injuries treated by SMA First Aid captures a much greater proportion of injuries than those currently accounted for as presentations to hospitals or medical centres, or counted via health insurance surveys. The fact that severe injuries are identified and counted separately may offer a means of estimating the total injury count across a population.

Following the trial, the SMA(ACT) Committee required that statistics collection continue for coverage during 2005 and beyond. The resulting 2005 data covered a wide range of different sports (more than 12), with lots of participants (93,000) and lots of opportunity to get injured (4,200 hours). The breakdown by injury type held no great surprises, nor was it possible to make much of the absolute figures given the variety of sports and variable duration of risk. However, it did indicate that 67 out of roughly 2000 injuries (a bit under 3.5%) were severe.

Given the ACT population (330,000), the numbers are such that, in broad terms, the trial population might be considered as approximating the ACT as a whole. So the proportion of all injuries counted by SMA that are considered severe should be reasonably close to the proportion of severe injuries that occurred in the whole of the ACT over the same period. So, if the number of severe sporting injuries in the ACT over the period were known (roughly equal to A&E presentations due to sporting causes), then a reasonable estimate of total sporting injuries in the ACT could be calculated.

Unfortunately, in 2005 the ACT Department of Health did not keep records of whether or not presentations to hospital A&E departments were sporting injuries, but to do so would presumably be just a case of managing the process and finding resources.

SMA, as a national organisation, offers coverage in most areas of Australia. If this injury recording methodology were used on a regional, state or national basis, it could provide a valuable source of injury data where currently there is none; and this could be a fertile field for epidemiologists to play in.

Acknowledgments

Sincere thanks go to:

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John Lockie and Patricia Donoghue are Level 2 Sports Trainers. This article is based on a paper they presented at the 2006 SMA Southeast Regional Conference.

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et al, 2007), whereas the bilateral L5 defects may involve a more 'symmetric' hyperextension of the lumbar spine. In the adolescent fast bowlers, the pars at the L5 and L4 vertebral levels may be particularly vulnerable to stress injuries as the maximal strength of the neural arch in these caudal vertebrae may not occur until 30 years of age, although in practice differences in the timing and/or the injury mechanism/s for lesions at these levels would appear to have implications for clinical decision making and potential interventions for injury management/prevention strategies.

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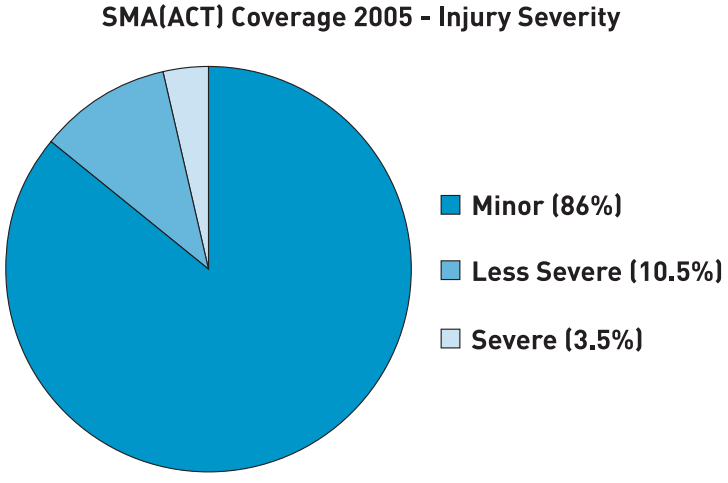

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Rugby league injuries at state of origin level

John Orchard and Wayne Hoskins

Injury incidence for the NSW Origin team over the period 2000-2006 was calculated as 327 injuries per 1000 player hours (based on medical presentation) or 98.9 injuries per 1000 player hours (based on missing a following game). These rates are significantly higher than the comparative rates at an NRL club (the Sydney Roosters, with rates of 247 and 34.1 respectively) over the same time period. However, there are biases which could account for the higher calculated injury rates, including greater availability of medical staff at Origin level and fewer days until the following game after an Origin match.

Rugby league is a collision-type sport played in Australia, New Zealand, England and France at the professional level. There are 13 players on the field at any given time with an interchange bench of 4 players. A maximum of 12 player movements per match are permitted, including interchanging for the blood bin and injuries[1]. Matches typically last for 80 minutes. Rugby League has a high rate of injury, particularly contact mechanism injury[2, 3], as tackles occur in the game approximately every 10-15 seconds. Players are involved in 20-40 physical confrontations per match[4] with the percentage of injuries caused by tackling ranging between 38.2% and 77.2% [5]. In the hierarchy of matches played, international matches are officially the 'top' level of the game. However, the traditional three-match State of Origin series, played between New South Wales and Queensland during the middle of the season, is considered to have perhaps the highest intensity of all matches.

Rugby league injury incidence has been previously reported. Although a number of injury definitions have been used, a large number of studies have defined an injury as that requiring a 'missed match'[5, 6]. Studies using this definition have documented incidence rates that have varied between 34.4 and 52.3 injuries per 1000 hours[5]. While muscular injuries (haematomas and strains) are the most frequently occurring injuries in professional rugby league[7, 8], when an injury definition requires a 'missed match', joint and ligament injuries and bone fractures become more frequent, particularly affecting the knee, ankle and shoulder[5].

An increased risk of injury with higher intensity play has been hypothesised[9]. Thus, it was the objective of this study to present the incidence of injuries over a seven-year period from 2000-2006 inclusive (21 matches) for one State of Origin team (New South Wales) and to compare the incidence to that seen at an NRL club (the Sydney Roosters) over the same seven-year period. The first author of the study was the team doctor for the two teams over this period.

In addition to being a descriptive study, a particular hypothesis to be tested was that the intensity of State of Origin would lead to an increased incidence of injury, with the null hypothesis being that there would be no detectable difference in the injury rate between the NRL team and the State of Origin team.

Methods

The medical officer for both the State of Origin and Sydney Roosters team prospectively recorded all injuries presenting for treatment into injury databases. Included in the databases were all occasions of players leaving the field (and being replaced) due to injury or illness and whether the player was subsequently able to return to the field or not and whether or not injuries caused players to miss subsequent games. The scope of the study was all games for the NRL (National Rugby League) matches (regular season and

Table 1 - Format of State of Origin series 2000-2006

Year	Interchange rule	Timing of matches	Time between games	Result
2000	Unlimited interchange	Wednesday nights	Two weeks	NSW 3-0
2001	12 interchanges per team	Sunday nights	Four weeks	Qld 2-1
2002	12 interchanges per team	Wednesday nights	Two then three weeks	Drawn 1-1
2003	12 interchanges per team	Wednesday nights	Two then three weeks	NSW 2-1
2004	12 interchanges per team	Wednesday nights	Three weeks	NSW 2-1
2005	12 interchanges per team	Wednesday nights	Three weeks	NSW 2-1
2006	12 interchanges per team	Wednesday nights	Three weeks	Qld 2-1

Table 2 – Match injuries during Origin games for NSW team

Year	Game	Match injuries	Players leaving field injured	Lacerations	Missed no games	Missed one game	Missed 2-3 games	Missed 4 of more games	Missed entire season	Total missed any games
2000	1	6	1	2	1	1		2		3
	2	3	3	1	0	1			1	2
	3	5	4	1	3		1			1
2001	1	6	0	3	3					0
	2	5	0	2	0	3				3
	3	3	0	0	3					0
2002	1	6	2	2	2	2				2
	2	7	1	3	0	3	1			4
	3	5	0	0	3	2				2
2003	1	6	2	1	4	1				1
	2	5	2	1	2	1	1			2
	3	7	2	1	4			1	1	2
2004	1	7	0	0	6			1		1
	2	5	0	0	4	1				1
	3	5	0	2	2			1		1
2005	1	6	0	1	5					0
	2	6	1	0	1	3	2			5
	3	11	1	1	7	3				3
2006	1	5	1	0	4			1		1
	2	4	0	0	4					0
	3	6	1	1	3		1		1	2
Total	21	119	21	22	61	21	6	6	3	36

finals) and New South Wales State of Origin matches.

The format of the State of Origin series each year is listed in Table 1.

A match injury recurrence (for the State of Origin team) was defined as an injury to the same body part which had been medically assessed prior to the start of the match and which caused the player to miss subsequent games for his club after the Origin match.

Comparisons between the injury incidences were done using a Taylor Series expansion and 95% confidence intervals. Compared to other methods for calculating confidence intervals, this generally leads to slightly wider ranges.

Results

Match injury incidence for Origin games is detailed in Table 2, with comparative rates for the Sydney Roosters (at NRL level) over the same time period detailed in Tables 3 and 4. The injury rates for the two levels of play are similar although Origin injury rates are slightly higher, taking into account the various definitions of injury. The exception was injuries causing players to leave the field, which was higher at NRL level than at Origin level (although not reaching statistical significance).

Serious injuries

As seen in Table 2, there were only three injuries which occurred during the 21 Origin team matches that caused the player to miss the entire remainder of the season (approximately 3 months). One was a degenerative knee condition that appeared to have an acute onset when the player was scoring a try during an Origin match. However, the player had suffered some knee soreness for the previous month (although neither the club nor Origin medical staff had noticed an effusion). This has been recorded both as an Origin match onset injury (although it had a gradual prodrome) and as an injury recurrence. Another injury was an acute onset shoulder instability episode which involved a moderately-severe axillary nerve palsy. Although this same player had been carrying a chronic A/C joint injury on the same side, this shoulder injury was not considered a recurrence. Subsequent to these two major injuries, the players involved missed game time in the season after the onset of injury. The third match injury which caused the player to miss the remainder of the season was a grade III knee MCL injury.

The six match injuries that caused the players involved to miss at least four weeks (but not the remainder of the season) were a fractured clavicle, a fractured thumb, a grade II hamstring strain, another knee MCL injury, an ankle syndesmosis sprain and chronic ankle posterior impingement.

Table 3 – Match injuries during Roosters NRL (first grade) games

Year	Games	Player hours	Injuries	Players leaving field injured	Lacerations	Missed one game	Missed 2-3 games	Missed 4 or more games	Missed entire season	Total missed any games
2000	30	520	184	56	21	8	6	3	2	19
2001	27	468	103	27	14	2	6	4	1	13
2002	28	485	127	37	24	8	8	3	4	23
2003	27	468	101	32	17	8	3	4	1	16
2004	27	468	87	36	10	5	2	5	0	12
2005	24	416	101	25	15	7	2	3	0	12
2006	24	416	99	29	7	3	7	2	3	15
Total	187	3241	802	242	108	41	34	24	11	110

Table 4 - Comparison of match injury incidence (NSW Origin vs. Roosters NRL)

Series	Any medical presentation	Incidence any missed games	Incidence 2 + missed games	Incidence 4 + missed games	Incidence lacerations	Incidence injuries leaving field
Origin 2000-2006	326.9	98.9	41.2	24.7	60.4	57.7
Roosters 2000	353.8	37.8	21.9	9.9	40.4	107.7
2001	220.1	28.8	24.4	11.1	29.9	57.7
2002	261.7	49.1	32.0	15.0	49.5	76.2
2003	215.8	35.5	17.8	11.1	36.3	68.4
2004	185.9	26.6	15.5	11.1	21.4	76.9
2005	242.8	30.1	12.5	7.5	36.1	60.1
2006	238.0	37.6	30.1	12.5	16.8	69.7
Roosters 2000-2006	247.4	34.1	21.4	10.9	33.3	74.7
Odds ratio (Origin: Roosters) incl. 95% CI	1.32 (1.06-1.65)	2.90 (1.96-4.29)	1.93 (1.09-3.40)	2.28 (1.09-4.78)	1.81 (1.13-2.91)	0.77 (0.47-1.27)

One potentially serious match injury suffered was a pneumothorax although, in terms of missed football time, this only caused the player to miss two club matches and he played his next match in another Origin game three weeks after the initial injury. He successfully completed this game although apparently had a recurrent rib injury later that season when playing for his club (although no recurrence of the pneumothorax).

No NSW players suffered knee ACL injuries in Origin matches over this seven-year period, although one player who was selected in the squad was ruled out in camp with a knee ACL injury that had occurred playing for his club the weekend prior. It is noted incidentally that one Queensland player was known to have suffered an ACL injury in the Origin series over the same time period.

Injury risk of State of Origin matches

The raw risk of being injured during a State of Origin match (causing the player to miss a club match) is 10% (36/357). This compares to a 4% risk of being injured during a Roosters NRL match (and then missing the following match) over the same time period (110/3077). The player game exposure of 3077 for the Roosters is calculated as being 17 (number of players in a team) multiplied by the number of Roosters games per season except for the final match of the year. The final match of the year is not included in this exposure calculation as there was no match available to miss the following week.

This difference in injury risk is statistically significant, meaning that it is unlikely to be due to chance. However, the true reason for the difference is probably mainly because the next game for Origin players is scheduled in 2-4 days time (for Origin matches other than in 2001), compared to an average of seven days for Roosters NRL games. The risk of missing more than one game was 4% for Origin players (15/357) compared to 2% for Roosters players (69/3077).

Management of lacerations

Over the 21 Origin games studied, there were 22 lacerations that required closure. Eleven of these were initially closed with staples, five were closed with sutures and six with skin glue. In the time period from 2001-2006, when limited interchange was used, only one player was forced to interchange off the field to have his laceration managed (and this was a forward who the coach elected to have leave the field anyway). Other

Table 5 - Training camp assessments NSW Origin team

Year	Game	Injuries assessed	Illnesses treated	Injuries which:				Players ruled out during camp:		
				Were new from player's last match	Caused player to miss previous match	Were ongoing but had not led to miss	Occurred during training camp	With pre-existing injury	Due to injury in camp	Due to illness in camp
2000	1	7	0	3	0	4	0	2	0	0
	2	6	2	2	2	2	0	1	0	0
	3	7	3	5	1	1	0	1	0	0
2001	1	10	1	6	1	3	0	0	0	0
	2	9	0	5	2	2	0	1	0	0
	3	10	2	6	2	2	0	3	0	0
2002	1	7	4	4	1	2	1	1	0	1
	2	11	2	6	2	3	2	1	1	0
	3	10	1	4	2	4	1	2	0	0
2003	1	11	4	7	0	4	0	0	0	0
	2	9	1	6	1	2	4	0	0	0
	3	7	4	2	1	4	2	1	0	0
2004	1	15	4	6	1	8	0	4	0	0
	2	10	3	6	2	2	1	4	1	0
	3	9	0	6	2	1	2	1	0	0
2005	1	11	6	4	0	7	2	0	0	0
	2	14	1	6	0	8	1	0	1	0
	3	15	1	4	3	8	1	5	0	0
2006	1	9	4	4	0	5	3	1	1	0
	2	8	9	2	0	6	1	0	0	0
	3	15	4	3	1	11	1	0	0	0
Total	21	210	56	97	24	89	22	28	4	1

players were initially managed by team training staff with gel, gauze and tape and then had their wound closed by the doctor at the first available opportunity. Although the process of stapling players on or near the sideline is controversial10, it has definitely allowed interchanges to be 'saved' by the NSW Origin team over this time period.

As can be seen from Table 4, the match incidence of lacerations in Origin of 60.4 injuries per 1000 player hours is significantly higher than the rate at the Roosters over the same time period of 33.3 lacerations per 1000 player hours.

Use of cortisone and local anaesthetic

Origin players were injected 39 times with local anaesthetic to play over the time of the study, representing 10.9% of players taking the field. This is a very similar rate of injection (and for a similar profile of body parts) to that used by the same first author for regular season NRL matches11. Of these, approximately half (17) were for injuries previously being injected by their club doctors in NRL games. Six of the 39 injuries were not injected pre-game by prior arrangement but were performed during the match for an injury that occurred in the match itself. In addition, six extra players (on top of the 39) used an EMLA patch (topical local anaesthetic) to play.

Over the same time period, 12 cortisone injections were used on Origin players (in 21 training camps). Exact comparative figures for the Roosters for cortisone injections are not available, but the Origin rate is likely to be higher. The 9-10 day period of an Origin camp gives a more desirable 'rest period' after a cortisone injection, if completed early in the camp, so that some chronic injuries (eg, bursitis) could be managed this way in camp. It is problematic avoiding contact training in the days after a cortisone injection in the regular season, given the average of seven days only between matches.

Injury recurrence

There were few recurrences from the 210 injuries assessed during Origin camps that worsened during Origin matches. Incidents which were or may have been considered recurrences included:

1. A player who took a chronic ankle posterior impingement condition into an Origin game, which worsened during the game. He elected to have mid-season surgery after this game (mentioned above under serious injuries) and returned later in the season.

2. A player who took a rib cartilage injury into an Origin game and, in a new incident, was accidentally kicked in the chest and suffered a pneumothorax (also mentioned above). While technically the rib cartilage and lung are separate body parts, the overlap between a rib injury and a traumatic pneumothorax is such that this injury was considered to be a recurrence.
3. A player who took a quadriceps strain into the game and suffered a minor re-strain in the final minutes of the match. Although he actually played very well, vindicating the selection, because he was unable to back up for his club this technically was a recurrence. He only missed the one match for his club.
4. The player also mentioned previously under serious injuries who had been suffering what appeared to be minor knee soreness coming into an Origin match and then had an acute episode during the match to the same knee.

Although episode number 3 was 'unlucky' to be considered an injury recurrence (as the selection to play was probably correct), there was one player who re-sprained an ankle during an Origin match and also didn't play for his club the following weekend. However, he was suspended for one match from an incident in the same Origin match, so technically he did not miss a match after the Origin with a recurrence from the injury.

This list of injury recurrences makes the percentage of injuries which were assessed that recurred 2% (4/210). Expressed as a percentage of team matches, there were 0.19 injury recurrences per team match.

By comparison, the Roosters had 26 injury recurrences over the time period 2000-2006 (187 NRL matches), from a total of 494 injuries that were considered prior to the match to be 'at risk' of recurrence. This reflects an injury recurrence rate of 5% (26/494) and a rate of 0.14 recurrences per team match. It is difficult to draw any conclusions between the recurrence rate at NRL level and Origin level because these rates vary in an inconsistent fashion. The recurrence rates at both levels are fairly low but obviously not zero.

Discussion

Previous literature has demonstrated that severe injuries are more common at higher levels of play at the professional level[12, 13]. This has been suggested to be the result of factors such as an increased intensity of play, increased player fatigue and pressure on players to participate with minor injuries which are susceptible to exacerbation and more severe injury[14]. At the professional level an increasing number of players will miss a match each week with injury as the season progresses[15]. However, during the finals series this number decreases. This has been hypothesised to be a result of more aggressive medical management and players being more willing to take risks and carry injuries into important games[15]. A similar situation may exist with State of Origin rugby league, with it being a highly sought-after selection, so players may be more likely to want to carry an injury into the game. On the other hand, at Origin level there is often pressure from a player's NRL club on the Origin medical staff to rule out players who are carrying injuries that have any significant risk of recurrence, as the cost of any recurrence would be carried by the club more so than the Origin team.

A similar dilemma occurs in other sports, most notoriously in soccer, where a player's club side (eg, an English Premier League team) may argue that a player should rest an injury whereas his national team may argue that he should play in an international game. This arises because soccer internationals (like rugby league State of Origin) are often held mid-season. In sports or competitions where the international or representative games are held at the end of the club season, there is relatively less pressure from the club to have players rest minor injuries. It is also worth noting that the concept of a State of Origin match was originally used in Australia in the sport of Australian Football for interstate matches between Victoria, South Australia and Western Australia. However, the AFL has ceased holding mid-season State of Origin matches in recent years, partially because too many selected players were prevented from playing in them by their clubs when carrying minor injuries.

Lacerations are a very frequent injury in rugby league[7], with the findings of this study suggesting they are more

frequent in the State of Origin series. Despite this high incidence, most of these injuries are dealt with on the field of play rather than utilising one of the 12 limited interchanges available. In rugby league there is 'limited' rather than 'zero' tolerance for player bleeding. If a player is seen to be bleeding, the referee allows him to remain on the field and have the wound attended to before re-joining the play. If he is seen to be bleeding a second time, the referee can then force him to leave the field. This ruling is now preferred to the use of a 'blood bin' with a free interchange, as competitions which have trialled this have considered that too much advantage was given to teams which received free interchanges from 'blood bins'. A number of procedures are used to close wounds such as bandaging, suturing and stapling[10] and generally lacerations do not cause the player to miss any subsequent matches.

A lack of literature documenting injury recurrence exists in the sport of rugby league (as it does for many other sports). At the professional level, recurrence rates have been measured at approximately 10% of all injuries occurring[12], with the most common injury types to be prone to recurrence being back injuries, rib injuries, hamstring and quadriceps strains[15]. However, defining an injury recurrence and an 'at risk' injury remains difficult.

Further injury surveillance is required at the NRL level to assess the impact that participation in State of Origin matches has on players for the duration of the season. This has received anecdotal attention in recent seasons as it has been suggested that teams with more representative players often suffer a slump in performance for 1-2

months after the Origin series due to a combination of player fatigue and injury. It would be interesting to compare injury rates in NRL games for the remainder of the season between Origin representatives and non-Origin players to see whether there was a major difference.

Recognised limitations exist in the study conducted. The number of players participating in State of Origin and the number of total matches is far less than that of even a single NRL club, lowering the power of the study. The definition of an injury, which is subject to debate in the rugby league literature[16], is hard to apply consistently between Origin and NRL levels. Although the team doctor was the same for both teams in this study, at Origin level all training sessions and even team functions were attended by the doctor whereas for the Sydney Roosters only matches, injury clinics and occasional training sessions were attended by the doctor. This gives a bias towards medical presentation at Origin level, compared to NRL level.

If a 'missed game' definition of injury is used, there is again a bias towards Origin games appearing to have a higher injury rate. This is because players must generally 'back up' within 2-4 days after their Origin game for their club side, as opposed to the usual 5-9 day recovery period they would receive after a standard NRL match. Certain minor injuries that would recover within seven days may not have recovered within the 2-4 day period. Notwithstanding this bias, if a player does miss an extra match for his club, it has the same impact on team performance as if he had missed a match from an injury playing in an NRL game, so it is not misleading to conclude from this study that State of Origin games are more likely to lead to players missing further matches through injury than regular NRL games.

Conclusion

As the rates of injury are higher for State of Origin matches than NRL games under most categories examined (including lacerations) it suggests that there is a consistently slightly higher injury incidence which may be due to the increased pace and intensity of the game. However, because of the biases present in the study, further research is required to confirm the hypothesis that the higher intensity of State of Origin leads to a higher injury rate.

Authorship and acknowledgement

John Orchard is the Sydney Roosters medical officer, a position he has held from 1998-present. He was NSW Origin doctor from 2000-2006 and has a PhD and MD in sports injury epidemiology.

Wayne Hoskins is a medical student at the University of Melbourne who has previously published papers on rugby league injury epidemiology.

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Rotator Cuff Tear

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Rotator cuff tears are among the most common causes of shoulder pain and dysfunction in adults. It is estimated that approximately 65% of the shoulder cases seen by orthopaedic surgeons and nearly 33% of all orthopaedic injuries are related to rotator cuff pathology. Research studies have shown that a majority of individuals over the age of 60 have significant rotator cuff disease including tears with 100% of individuals over the age of 70 exhibiting some form of rotator cuff disease. The prevalence of rotator cuff tears (partial or full) greatly increases after the age of 50, with more than 50% over the age of 70 having a tear. In addition, more than 80% of those over the age of 80 had a rotator cuff tear. In a community survey of 644 individuals older than 70 years of age, approximately 21% had some type of shoulder pain related to the rotator cuff. Magnetic resonance imaging (MRI) has demonstrated the incidence of rotator cuff tear and reported that 54% of the 46 individuals over the age of 60 had some type of rotator cuff tear. Of the individuals who were under 40, only 4% exhibited a tear. From these results, it appears that rotator cuff lesions are a natural correlate of ageing.

Pathology of rotator cuff tendon

The rotator cuff is one of the largest tendonous structures in the body, playing a key role in guiding movement and stability at the shoulder. High functional demands placed on the rotator cuff may subject the tendon to tissue overload and failure, with pain manifesting secondary to rotator cuff tear12. Rotator cuff disease was classically described by Neer as progressing from reversible subacromial impingement (Stage 1 rotator cuff disease) seen in younger individuals to irreversible rotator cuff tears (Stage 3 rotator cuff disease) seen in older populations. Both extrinsic and intrinsic factors have been discussed as causative mechanisms of rotator cuff disease. Extrinsic factors include primary and secondary subacromial impingement and acromion morphology. Extrinsic factors like impingement result in tendon fraying from the pinching of the supraspinatus tendon between the anterior portion of the glenoid and the coracoacromial arch during the functional task of arm elevation. This impingement can lead to secondary, intrinsic factors accelerating the rotator cuff pathology. Intrinsic factors include vascularity abnormalities and primary degenerative changes within the substance of the tendon. Vascularity abnormalities are often attributed to the "critical zone". This zone is present when the head of the humerus occludes vascularity of the supraspinatus tendon during shoulder abduction. Chronic micro-trauma occurs from repetitive shoulder motion, which can develop into partial and complete tears. Many of the changes produced by decreased vascularity and chronic micro-trauma have been attributed to ageing. These degenerative changes have been observed in patients as early as their third decade. It is believed that, as individuals get older, degenerative changes, such as loss of muscle fibre integrity, decreased cellularity and deformity in the articular surface of the glenohumeral joint, occur more frequently, thereby increasing the likelihood of chronic soft tissue degeneration.

Rotator cuff degeneration is often the combination of two or more intrinsic and extrinsic factors. This degeneration initially develops in the supraspinatus tendon near its anterior insertion. Supraspinatus tears tend to cascade posteriorly into the infraspinatus then anteriorly across the bicepital groove into the subscapularis. This 'cascading effect' increases the load on neighbouring, unaffected fibres. The supraspinatus and infraspinatus are the two most common tendons involved with rotator cuff disease. Previous observations have shown that as tears migrate into neighboring tendon(s), post-operative strength, active range of motion and patient satisfaction suffer while the need for surgical intervention increases. It is commonly recognised that functional outcome negatively correlates with the number of tendons involved (ie, more tendon involvement results in diminished function). For example, patients with isolated supraspinatus tears have a higher functional capacity to perform overhead tasks than patients with a rotator cuff tear involving both the supraspinatus and infraspinatus. Patients with small full thickness rotator cuff tears (ie, isolated supraspinatus tears) have a significantly higher rate of good to excellent outcomes compared to patients with larger tears that involve the supraspinatus and infraspinatus.

Functional impairment with rotator cuff tears

Individuals diagnosed with a rotator cuff tear commonly describe an impaired ability to perform common activities of daily living that require shoulder elevation overhead. Impairment included inability to lift a milk container, comb one's hair and reach a high shelf prior to surgery. Preoperative patients demonstrate an inability to actively flex, abduct and rotate the involved shoulder. Resisted elevation was also diminished in these patients. In a study of 237 shoulders with rotator cuff tears, 50% of the patients were unable to lift a 1 lb object to a shelf, toss underhand, wash the back of the opposite shoulder and do their usual work. Those with a rotator cuff tear had difficulty lifting 8 lb

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Science in Australian sport: Its origins and challenges

Frank Pyke *

One of the significant factors associated with Australia's improved performance in international sport during the past two decades has been the use made of science and technology in preparing athletes for competition. Its sport scientists have become widely regarded throughout the world for their work with high performance athletes and for the innovative technologies that they have developed.

Science was first introduced to Australian sport back in the 1940's and 50's when Professor Frank Cotton from the Department of Physiology at the University of Sydney teamed up with fellow scientist and swimming coach, Forbes Carlile. Together they developed scientifically based training programs which were implemented by the coaches of several swimmers who went on to become Olympic champions at the 1956 Games in Melbourne. These included Dawn Fraser, Murray Rose and Jon Henricks. It was at Cotton's suggestion that Henricks made the successful transition from distance swimmer to sprinter and, in Melbourne, won the 100 metre freestyle and was a member of the winning 4 x 200 metre freestyle relay team.

Cotton spent time during the 1930's working as a foreign research fellow at the famous Fatigue Laboratory at Harvard University in Boston. This multi-disciplinary laboratory was active between 1927 and 1947 and involved physiologists, biochemists, physicians, psychologists and sociologists principally dedicated to conducting both field and laboratory research associated with the World War II war effort. However, it also had a close connection with sport. Some of the subjects studied were champion runners such as Clarence De Mar who competed in 32 Boston Marathons, winning seven, and Glenn Cunningham and Don Lash, world record holders in the mile and two mile, respectively.

The Harvard Fatigue Laboratory had a major impact on our understanding of exercise and sport physiology not only within North America, but internationally. Like Cotton, several European scientists from Scandinavian countries as well as others from Italy, Belgium and Germany worked there during this era and then returned home to apply their learnings.

Cotton's background in physiology, combined with his experience as a champion swimmer, led to him developing talent identification tests on bicycle and rowing ergometers and conducting research projects on swimming, running and rowing training. His influence was significant and provided an early cutting edge in the training of athletes. He is regarded as "the father of sport science in Australia".

Following Professor Cotton's contribution, there was a lengthy period when sport science progressed only slowly as it tried to gain a toehold in the Australian University system. This was finally achieved in the 1960's and 70's, mainly as a result of the efforts of a number of physical educators who had completed post-graduate qualifications in exercise and sport science in North America and then returned home to play leadership roles in University programs. Their contribution was supplemented by others who had a strong interest in sport and were located in University departments of anatomy, physiology, psychology, engineering or the physical sciences.

Initially the dominant sub-discipline was exercise physiology but others, such as biomechanics, skill acquisition and sport psychology, developed rapidly. Interest in information processing and motor control occurred a little later and the sub-discipline associated with developing and refining skill was subsequently labelled motor behaviour. Sport psychology, which was firstly aligned with skill acquisition, also developed independently with a specific focus on assisting participants with mental strategies and techniques.

Unfortunately, none of these advancements occurred soon enough to prevent Australia's dismal performance at the 1976 Montreal Olympics where it won only five medals, none of them gold. There was a public outcry regarding these poor results which acted as a catalyst for Federal, State and Territory Governments to direct more funding into elite sport. Subsequently the Australian Institute of Sport was opened in Canberra in 1981 and, during the following fifteen years, similar organizations were established in each State and Territory. Within this national network of Institutes and Academies of Sport, sport science was regarded as an essential ingredient of high performance programs and scientists from each of the sub-disciplines were employed to assist coaches develop their athletes.

While international success did not come immediately, there were clear signs of a performance revival at the 1992 Olympics in Barcelona where the Australian team won seven events and a total of 27 medals. And then, at both the Sydney 2000 and Athens 2004 Olympics, Australia amassed its highest ever number of total and gold medals respectively,and on both occasions finished fourth on the medal tally among competing nations. Excellent results have also been achieved by Australian teams in recent Winter Olympic, Paralympic and Commonwealth Games as well as in non-Olympic sports such as cricket, netball and golf.

During this period, sport science has made rapid progress in Universities throughout the country and course graduates have played key roles in the preparation of high performance athletes; some with national teams or professional football clubs and others with Institutes and Academies of Sport. Sport science is also an important

component of courses offered within the national coaching accreditation scheme which provides coaches who work in the high performance area with a solid grounding in each of the sub disciplines.

Some scientists have developed close relationships with head coaches in particular sports and between them they have had a significant influence on the performances of individual athletes and teams. Others have either become successful elite coaches or high performance program managers and, in these roles, have had an even more direct effect on the quality of athlete development programs.

While sport scientists can take some of the credit for Australia's turnaround in international sport, there are still significant challenges ahead if they are going to continue to provide athlete preparation programs with a competitive edge. It will require greater emphasis being placed on collaboration, research and development, succession planning and individual athlete programming.

Collaboration

Some scientists need to adopt a more collaborative mind-set, where they not only work closely with athletes and coaches but with all other members of the athlete support team. Too often we find scientists from a particular sub-discipline preferring to work independently. This raises the question- Is sport science fragmenting? Is there too much specialization and not enough integration. A multi-disciplinary approach is required to maximize the benefits of science to the athlete. This is the case whether planning individual training programs, competition strategies or rehabilitation following injury.

While there are occasions when scientists from the same sub-discipline need to focus on a specific issue, they also need to understand that biological systems and organs are interrelated. This requires pooling the collective expertise of the multi-disciplinary support team which not only includes other sport scientists but also physicians, physio and massage therapists, nutritionists, physical preparation staff and career and education advisors. Good teamwork is based on open communication, a willingness to collaborate and a shared commitment to provide athletes with support of the highest quality.

Research and Development

If Australia is to continue to lead the way in applied sport science it must bolster its research efforts and encourage the development of innovative methods and technologies.

Scientists working within the Institute and Academy network are heavily involved in the preparation of athletes for competition which leaves them with limited time for research and development projects. Scientists within University departments of exercise and sport science find that the funding available for research into high performance sport is very limited so they seek grants in other areas, particularly from agencies in the health field.

Despite this, a number of innovative technologies have been developed in the areas of performance evaluation, equipment design, movement and game analysis, decision making and anticipation training which are world leading and have helped create a winning edge.

However, it is vital that more substantial funding is dedicated to research in elite sport. Grants need to be available to both the Sports Institute/Academy and University sectors in order to validate the content of existing high performance programs as well as discover new ways forward. Close collaboration between staff working in each of these sectors should be strongly encouraged in grant applications and throughout the conduct of research projects.

Succession Planning

The objective of succession planning is to facilitate a seamless transition from one generation to the next. Valuable information and skills have often been lost when a senior person such as a head coach or sport science coordinator leaves an organization.This is felt even more if that person moves to a rival club or overseas country.

In order to retain some of this knowledge, it is important to have a mentoring system in place which prepares others to either fill the breach or remain within the organization in some expanded capacity. It is good management practice to identify someone within the organization who has the potential to replace an incumbent if it becomes necessary. This allows time to fill any of their competancy gaps, give them extra responsibilities and encourage their development.

The sport science trainee programs which exist in several Institutes and Academies of Sport have provided some opportunities for this process to occur. Young scientists in their final year of University studies have been placed with scientists and coaches in the network who act as their mentors. Several trainees have subsequently progressed to full-time positions within the placement organization or, alternatively, have found similar opportunities elsewhere in the national network or with national sporting organizations.

Individual Athlete Programming

Increased attention needs to be given to prescribing training programs based on individual need. The scientific support team is in the best position to play a lead role in this process. Where should training time be best spent - on fitness, technique, tactics or psychological attributes such as the capacity to concentrate and manage anxiety? How much recovery time should be allowed?

In order to maximize the overall effectiveness of the training program, it is important that the coach not only understands the demands of the sport but also the attributes of each athlete. Athlete evaluation procedures which identify individual strengths and limitations are part of the arsenal of sport scientists and should be utilised extensively in planning programs and monitoring progress.

Conclusion

If Australia is to maintain its present high standing in world sport it is essential that it continues to build on the early scientific work of Professor Frank Cotton and scientist / swimming coach Forbes Carlile in seeking to gain a competitive advantage over its rivals.This will require athletes to have state of the art training methods and cutting edge technologies at their disposal. A team approach, managed by the coach, in consultation with the athlete, and including scientists from each of the sub-disciplines as well as other support personnel, will go a long way to ensuring that the potential of the country's athletic talent is maximized.

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Ground conditions and injury risk

What do we really know?

By Dara Twomey

The social, economic and environmental effects of the drought on the farming community are widely publicised and acknowledged, however, the implications of these dry conditions on the risk of injury while playing sport on harder ground is also of critical importance to the well being of sporting communities. At present, natural turf surfaces throughout Victoria and elsewhere in Australia are being declared unsuitable for players and consequently closed for use. Therefore, it would seem both pertinent and opportune to examine the existing evidence of injury risk on harder, drier natural turf surfaces and the links that have been reported between ground conditions and increased injury risk.

Intuitively, there exists a relationship between extremes in surface conditions and injury. For example, a harder/drier surface would prevent the sliding that reduces torsional loading on the leg during sudden movement or contact with another player, but could increase the risk of injuries, such as fractures, when players are falling on the hard surface. Equally, a softer surface will reduce friction and cause slipping during sudden movement but will be a softer landing for players.[1] However, there has been a paucity of published studies in international sports science and sports medicine literature that have conclusively and validly related sports injuries to ground conditions. From an international perspective, various characteristics of ground conditions have been linked to injuries in such sports as American football, soccer, rugby union, and Gaelic football.[2,3,4,5,6] Many of these have been sports injury epidemiology studies which have not been able to determine causality between ground conditions and injury risk because, either they did not collect the necessary ground conditions/weather data during the study or they did not use appropriate methodology to enable this link to be made.[7] The majority of the research undertaken in this area in Australia has been in elite Australian Rules football and more recently in rugby league. Also, it is important to note that the emphasis has been on injuries to the lower limb in many studies and has even been restricted to specific lower limb injuries, such as anterior cruciate ligament injuries (ACL), in some studies. Factors including hardness, traction, grass type, and weather have all been cited as possible contributing factors in the link between injuries and ground conditions.

The two main surface characteristics that have been related to injury, particularly of the lower limb, are ground hardness (the effect that the surface has on absorbing impact energy) and traction (the type of footing or grip a surface provides).[8] Traction is most highly correlated with grass cover and hardness with soil moisture content.[9,10] An early-season bias reported in injury rates[11-14] was one of the main instigators for linking ground hardness with increased injury risk. In the seasons 1997 – 2000, Orchard[15] found that the rates of injury in the Australian Football League (AFL) in Victoria were lower than those of the more northern states of Australia. The greatest discrepancy of incidence due to location was in ACL injuries.[15] This was attributed to weather conditions and hence ground conditions but it is also important to note that the type of grass on the football fields varied with climate. Orchard (2001)[14] found there was no significant relationship between ground hardness and risk of ACL injuries at elite level football but there was a trend towards an increased risk when the ground was harder. While ACL injuries, due to their severity, frequency and burden on the health care system, have been the focus of much research on ground conditions, other non-contact injuries to the lower limb have also been reported in warmer, drier climates.[16]

Although the hardness of grounds in the Australian Football League (AFL) was measured using a penetrometer as an objective measure[15], most other studies used subjective measures or player recall to determine hardness.[17] Game speed has also been correlated with hardness of playing conditions at elite level football and rugby league, with harder grounds having a faster game speed.[18,19] Norton et al. (2001)[18], also reported that there would be an increased collision impact force on harder ground due to faster game speed. According to Milburn & Barry (1998)1, harder ground results in increased strain on ligaments and tendons and is therefore thought to contribute to higher injury rates. Interestingly in another study[20], although higher levels of injuries were associated with harder ground conditions this relationship disappeared when adjusted for time of the season, suggesting that the association initially found may have been spurious.[20] Also, in the UK when the rugby league season was changed from winter to summer they attributed some of their increase in injury incidence to ground conditions, but lacked solid evidence due to observational measures of the ground conditions.[21,22] Friction and torsional resistance from boots has been shown to be higher in drier conditions on natural grass compared to wet conditions[23] which may increase the risk of injuries. Moreover, Lambson et al. (1996)[24] found that the wearing of a boot with longer and more peripheral cleats was associated with an increased risk of anterior cruciate ligament (ACL) injury due to increased shoe-surface traction on natural grass. A factor often implicated in the non-contact ACL injuries is the interaction between the player's shoe and the playing surface[25], however there is a lack of reliable findings to support or refute this.

The main equipment used in previous studies for measuring ground hardness are the Clegg hammer and the

penetrometer. The Clegg hammer measures maximum deceleration for a light object but doesn't penetrate the thatch layer, and the penetrometer measures depth of soil penetration.[15] Penetrometers have revealed a slight softening of the ground over the progression of the winter season but can vary significantly with the amount of recent rainfall.[15] There appears to be no universally accepted tool to measure shoe-surface interaction, however, it is presently an emerging area of development. The studded boot apparatus which measures rotational traction or grip has increased in popularity but its use has not yet been well published. Importantly, the reliability relationships between these measuring tools, and their link with injury risk has not been well established.

Grass type has been a factor associated with injury, particularly anterior cruciate ligament injuries.[26] The main types of grasses used on football fields in Australia are, bermudagrass, kikuyu grass, rye grass and rye/annual blue grass mix. Most of the AFL grounds, where elite level matches are played, are covered in either rye grass or annual blue grass or a mixture of both of these.[27] Orchard (2002)[16] found in a study of AFL matches and grounds over a five year period that there was a 26% increased risk (1.26 relative risk) of lower limb injury on bermudagrass predominant grounds over rye grass predominant grounds. Rye grass is considered to lead to lower shoe-surface traction than bermudagrass because it creates less thatch and does not contain stolons which may create excess friction between shoes cleats and grass layer.[26,28-30] Chivers et al. (2005)26 have recently analysed the percentage of bermudagrass and annual blue grass over the course of the season on various AFL grounds and found a high correlation between grass type and ACL injury incidence. Their findings suggest that annual blue grass mixed with either rye or bermudagrass may have higher ACL injury risk than rye grass alone. Since rye grass has been traditionally associated with cooler drier climates it has been the predominant grass type on Victorian football fields. As a consequence of the current climatic changes and escalating drought experienced, it may no longer be the most suitable grass type for football fields in Victoria.

Naturally, the weather has a direct effect on the condition of the ground and hence has been a factor linked to injury risk and ground conditions. Increased rainfall results in increased soil moisture. Orchard (2001)[14] stated that in the longer term, traffic on grounds with greater moisture will have an adverse effect on the thatch layer of the grass. He found that ACL injuries in the AFL were associated with reduced rainfall over the previous year, and not over shorter periods, suggesting that long-term effects of rain on the thatch layer (reducing grass root density) were more important than the soil moisture content.[14] Orchard also found that weather conditions associated with dry field conditions were also significantly associated with injury risk.[14] The specific weather patterns were high water evaporation in the month before the injurious match and low rainfall in the year before the match.[14] In a recent study examining the influence of environmental and ground conditions on injury risk in rugby league, they also found that less rainfall was also associated with a higher number of match injuries.[19]

One major limitation of the research to date is that most of the ground conditions when related to injury have been based on subjective observations rather than direct measurements.[4,31] In most cases, the reliability of these observational checklists have not been established and their validity has been assumed. Another significant limitation with all of the work carried out on ground conditions linked with injuries in Australian Rules football to date is that it has all been based at elite level venues. The extrapolation of the results from these studies to sub-elite, community or junior level is questionable and has not been substantiated. Interventions such as ground watering, clearly inappropriate in drought conditions, have been suggested[14,15,32], but any intervention cannot be put into place until the exact nature and contribution of ground conditions and shoe-surface interactions to injury risk has been established. Furthermore, the interactions of grass type, player's choice of boot and shoe-surface interaction are not yet well understood. It would therefore seem premature to be making recommendations about what are acceptable ground conditions with respect to preventing injury.[33]

In conclusion, there would appear to be very little solid evidence to substantiate the notion that drought stricken grounds are much too dangerous to play on and require immediate closure. This is not to say that some players will not sustain injuries on hard playing fields and undoubtedly there would be an increase in abrasions, repetitive microtrauma injuries and possibly fractures. However, there is a paucity of evidence to suggest that there is a significant increase in injury rates and hence an increased injury risk. To date there has not been any research to link ground conditions in community grounds to injury risk in players using them. The fact that players may naturally adjust their playing behaviour as a protective mechanism against injury on harder surfaces must also be considered. The literature to date suggests that many gaps in this area of research need to be addressed to make significant advances and provide a solid evidence base for the development of injury prevention strategies in the future. Currently, work is being undertaken by the University of Ballarat to address some of the gaps and provide evidence of injuries related to ground conditions at community level football and to examine the validity and reliability of ground measuring equipment. The findings of this research, expected to be published in 2008, will undoubtedly have a positive impact on the health and wellbeing of sporting communities both nationally and internationally.

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above their head without bending the elbow and could not throw a softball overhead. It has also been demonstrated that patients with isolated supraspinatus tears had less difficulty with overhead tasks such as placing objects on to a shelf overhead than patients with supraspinatus and infraspinatus involvement, but were still dysfunctional.

Over the last three years, we have strived to identify the biomechanical, neuromuscular and pain factors that impair the overhead function in patients with symptomatic, full thickness tears of the supraspinatus and supraspinatus-infraspinatus. While data collection is continuing, an analysis of the current data suggests that individuals with full thickness rotator cuff tears demonstrate decreased humeral rotation strength (predominantly internal rotation); decreased humeral elevation strength; decreased external rotation, abduction, flexion and extension range of motion; decreased scapular upward rotation and elevation; and more variability in muscle activation patterns of the shoulder girdle, with suppression of the dynamic stabilisers being a common theme.

Additionally, these results are consistent after the injection of lidocaine to decrease pain (average drop in pain was three points on a 10 point VAS), suggesting that the deficits experienced are more likely the result of the actual tear, and not the pain associated with it. From the results of our research, physicians and therapists may now implement rehabilitative interventions either as a means of conservative treatment or prior to and following surgical intervention that specifically address the deficits identified. As a result, functional outcomes should exhibit improvement.

Dr Joseph Myers is Assistant Professor in Sports Medicine (School of Health and Rehabilitation Sciences) and Assistant Professor in Orthopaedic Surgery (School of Medicine) at the University of Pittsburgh and one of the keynote speakers at the 2007 SPA Conference. For a full author biography and details of Joseph's conference presentation, visit the APA website: http://www.apaconferenceweek07.asn.au/nsg/spa_program.htm

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The competitive standards in international sport are forever on the rise and being good enough today provides no guarantee that this will be the case tomorrow. Everyone involved in the prepararation of athletes must strive for their continual improvement so that good performances become even better, until the better ones become the best. The use of modern science and technology is an essential part of this process.

Further Reading

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***Dr Frank Pyke was the Executive Director of the Victorian Institute of Sport between 1990 and 2006 and is now an Adjunct Professor at Deakin University and the Universities of Queensland and Ballarat.**

Notice of Annual General Meeting and Call for Nominations

Notice is hereby given that the Annual General Meeting of Sports Medicine Australia will be held at the Adelaide Convention Centre, North Terrace, Adelaide, South Australia at 4.45PM Tuesday 16 October 2007.

Agenda

1. Opening
2. Roll Call, Apologies and Proxies
3. President's Welcome
4. Minutes of the Previous AGM
5. Reports
6. Consideration of financial statements & audit report
7. Board Election (if required)
8. Appointment & remuneration of auditors
9. Special Business
10. Close

Call for Nominations – Board of Directors

Members are asked to provide nominations for positions on the Board of Directors of Sports Medicine Australia.

Executive Members:

- President
- Vice President
- Financial Director

National Directors

- NSW
- South Australia

Discipline Director

I _____ of _____

hereby nominate _____

for the position of _____

on the National Board of Directors of Sports Medicine Australia

Proposer's Signature _____ Date _____

Seconder (full name) _____

Seconder's signature _____ Date _____

Nominations should reach: Sports Medicine Australia, PO Box 78, Mitchell, ACT 2911 or fax to (02) 6241 1611

BY NO LATER THAN 5.00 PM (EST) ON MONDAY 24 September 2007

Notes to the validity of nominations to the Board of Directors of SMA

Appointment and Election of the Executive

Any nominee for the Executive shall not be eligible unless they have served on the Board for 2 of the last 5 years. A nominee for the position of President must also have served on the Board for the 12 month immediately prior to his nomination.

A retiring President shall not be eligible for any Executive position for a period of 2 years following his retirement from the office of President.

Appointment and Election of National Directors

Each State Branch shall elect a National Director from and by the Federation membership in their state through elections coordinated by the CEO.

Any nominee for National Director shall not be eligible unless they have served at least two of the last five years on their State Council or Board.

Appointment and Election of the Discipline Director

Discipline Groups will be asked to vote for nominations to the position of the Discipline Director at their Discipline Group AGM.

The Discipline Director will be elected at the AGM by the Council of Disciplines.

Any nominee for Discipline Director must be a member of a Discipline Group.

Thomas Franklyn Penrose (1933-2007)

It is with great sadness that I announce that Tom Penrose passed away early Tuesday morning, 12 June 2007, after a short but acute fight with cancer. He only began feeling ill in late April this year and was diagnosed with cancer just 3 weeks ago. His son, Jason, let us know that it was a very rapid deterioration but, fortunately, he did not suffer badly or for long.

Tom was a passionate pioneer of Exercise Science and Rehabilitation here at Wollongong and throughout Australia, and for this reason I would like to share a few highlights of Tom's career. After completing a Diploma of Physical Education at the University of Sydney (College of Education) in 1954, followed by teaching positions within the NSW Department of Education, Tom ventured to the University of Oregon to complete his Master of Science (1965). In February 1966 he joined the Wollongong Institute of Education as a Lecturer before traveling to the University of Western Australia in 1974 to undertake PhD studies (all but handing that thesis in). Tom then returned to Wollongong in 1978 to take up a Senior Lecturer position at the University of Wollongong, where he remained until retiring in 31 December 1996.

At Wollongong Tom was the driving force behind establishing, in 1984, the Human Movement and Sports Science program, which provided the foundation of the Exercise Science and Rehabilitation programs we have today. Twenty one years ago he also pioneered establishment of the Illawarra Academy of Sport, which has become a model for regional academies of sport across Australia. Tom was also a highly active member of the Australian Sports Medicine Federation (South Coast Branch), the Illawarra Sports Medicine Centre and, during its formative years, the Australian Association of Exercise & Sport Science, acting as National Secretary from 1991-1993. He also held positions as an Exercise Science and Injury Prevention consultant for numerous community organizations, including his beloved Illawarra Hawks NBL team.

I was privileged to have worked with Tom here at Wollongong for over a decade, sharing with him the experience of establishing those first courses in Human Movement and Sports Science. In fact, it was via Tom's support that I was given a chance to start my own academic career at Wollongong. Tom's unselfish passion and determined drive to develop the profession of Exercise Science, together with his love of basketball, will stay with me as inspiration to ensure we continue to provide innovative and professional programs in Exercise Science here at Wollongong and throughout Australia. Our hearts are with his wife, Patricia, and his children, Jason and Lisa, at this sad time.

Julie R Steele

Goings

This is the last edition to be prepared by Managing Editor, Dominic Nagle, who has sold out and gone to work for the AMA. The new Managing Editor will be Lesley Crompton (lesley.crompton@sma.org.au)