SPORTS PERFORMANCE
RESEARCH INSTITUTE, NEW ZEALAND
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Rugby Codes Research Group Newsletter

Welcome to this issue of the Rugby Codes Research Group (RCRG) newsletter. The aim of the RCRG newsletter is to "Communicate advances in evidence based knowledge and its practical application to the wider support network of rugby codes."

The Rugby Codes Injury Prevention and Performance Group (RCIPP) was established in February 2010 based on the prior work in rugby related research of Professors Patria Hume and Will Hopkins and their postgraduate students – specifically Dr Ken Quarrie, Dr Simon Gianotti and Dr Doug King. Although injury prevention and strength and conditioning was the original focus of the RCIPP, the expansion and creation of the RCRG in 2012 meant areas such as coaching, psychology, performance analysis, management and business were included. This exciting integrated approach means that knowledge across research areas is combined allowing effective holistic advancement of practice within the rugby codes. The RCRG includes members from undergraduate to professorial level and national and international collaborators. We have a diverse team that includes epidemiologists, biomechanists, physiotherapists, medical doctors, an emergency nurse, lecturers, postgraduate students, undergraduate exchange and Bachelor of Sport and Recreation third year cooperative students. Importantly we have practitioners from rugby league and rugby union as part of the group. Staff from other organisations such as ACC have also joined the RCRG.

The RCRG meeting on 29th August 2014 at SPRINZ on the AUT Millennium campus included:

- a presentation by Dr Doug King on his thesis work "Impacts in Amateur Rugby Union & League"
- discussion of Doug's work and his use of accelerometers, concussion assessment, and international collaborative projects
- discussion of the development of a national concussion policy
- discussion of project updates and potential research projects for rugby codes.

RCRG meeting attendees:
Front left to right: Doug King (SPRINZ PhD), Isaac Carlson (ACC), Tony Iro (NZRL), Dean Watkins (NZRL), Patria Hume (SPRINZ staff), Scott Brown (SPRINZ PhD), Lee Bridgeman (SPRINZ PhD).
Back left to right: Kim Simpringham (SPRINZ PhD), Mark Plummer (Blues), Kelly Sheerin (SPRINZ staff), Stephen Kara (Blues, SPRINZ Research Associate), Duncan Reid (AUT staff), Chris Whatman (SPRINZ staff), Matt Brughelli (SPRINZ staff), Alex Ross (SPRINZ PhD).

AUT MILLENNIUM

Contents

Impacts in amateur rugby union and rugby league

Doug King

At the recent RCRG meeting Doug outlined his work with the X2Biosystems X-Guard & X-Patch: Tri-axial accelerometer mouth-guard or behind-ear.

Key summary points were: There was a strong correlation with centre of gravity however there was an associated 10% error.

Definition: Not just hits to the head but forces transmitted to the head.

Verification: All games were verified and all activities outside of match play were omitted.

Limitations: Loss of connectivity, falling off (hair gels etc.) and not all impacts were recorded.

Measures calculated: Can we measure people at risk? We measured linear, rotational and combined probability for a complete picture. King-Devick Saccadic Test (K-D): Baseline and post-match assessment using an iPad v2. Doug personally fitted and applied all devices (mouth and ear) throughout data collection.

Results: Premier amateur rugby union (n=38) 20,687 impacts >10g (77 impacts/player/game). Forwards > Backs. Forwards: <linear and <rotational compared to backs. Two witnessed concussions and 20 silent concussions with K-D test. Amateur junior rugby league (n=19). 1,977 >10g (13/player/game). Males > females. 8 "silent concussions" identified with K-D test. Amateur premier rugby league (n=31). 13,895 impacts>10g (56 impacts/player/games). Forwards > backs. Forwards: >linear and >rotational compared to backs. One witnessed concussion and 8 "silent concussions" with K-D test.

Findings: Union > league in number of impacts. However, similar risk of concussions in both sports. How does rugby league compare to American football? Premier rugby league holds 2:1 on impacts where juniors are similar. Rotational force in rugby league was nearly 4x higher in premier and junior when compared with American football similar aged cohorts.

Key messages to take home:

- Concussion knowledge is very limited for impacts
- No single threshold for concussion
- Concussions occur despite impact severity
- Silent or non-witnessed concussions often go un-recognised
- Culture of 'just a knock' needs to change.

Rugby codes concussion policy

ACC leads a Sports Collaboration Group involving representatives from New Zealand Rugby, New Zealand Football, Netball New Zealand, NZ Rugby League, AUT's Sports Performance Research Institute New Zealand (SPRINZ) and AUT's National institute of Stroke and Applied Neurosciences (NISAN).

The group was established by ACC in January 2014 as part of the 2014-19 Sports Collaboration Strategy with the intent of '*supporting performance enhancement and growth of sport in New Zealand through safe participation and injury prevention*.' The group provides a leadership platform for organised sport in New Zealand with representatives from national sports organisations governing the country's most popular sporting codes.

The group has identified concussion in sport as a high risk area impacting sport in New Zealand and the safety of kiwi sportspeople. Sport-related concussion is an injury that is gaining profile in New Zealand and overseas. It is intended that ACC and the Sports Collaboration Group will develop an agreed National Sports Concussion policy and guidelines for New Zealand. The policy will provide a strategic framework and implementation plan to ensure New Zealand provides international best practice for the identification, treatment, rehabilitation and management of concussion in sport.

Professor Meeuwisse MD (University of Calgary Sport Injury Prevention Research Centre, and Zürich Concussion in Sport Consensus Group) will provide the bridge to the Zürich consensus and the international medical and science concussion group discussions.

A meeting of the Sports Collaboration Group will occur on the 17th October hosted by New Zealand Rugby League at Penrose. Key issues to be discussed will include the operational definition of concussion, concussion versus mTBI wording, evidence for biophysical effects of traumatic brain injury, age limits for management and return to play considerations (i.e. any differences for children), and assessment methods (e.g. King-Devick, SCAT3, SCC, baseline). Professor Meeuwisse will visit AUT Millennium on 5th December to meet with the Sports Collaboration Group and to provide a public seminar on the sport concussion consensus (11-12 noon).

April 2010 NZRL guidelines for concussion

The following information is derived from the April 2010 NZRL guidelines for concussion.

Definition, assessment (questions and signs and symptoms of concussion in sideline concussion check list; SCAT2), management, return to play protocol over 21 days.

- Players over the age of 16, a 21 day stand down period
- 16 or under shall observe a 28 day stand down period
- Return to play prior to this minimum stand down period can only occur with an appropriate neurological specialist assessment and clearance is given.

Level	Activity undertaken	Time post concussion (approximate) Guidelines
1	No activity, complete rest. Once symptom free and cognitive recovery is demonstrated, proceed to level 2.	2 – 3 days
2	Light aerobic exercise such as walking or stationary cycling	4 – 10 days
3	Sport specific training (e.g. running drills, ball handling skills)	11 – 15 days
4	Non-contact training drills	16 – 20 days
5	Full contact training after medical clearance	21 days
6	Game play	21 + days

August 2014 NZR guidelines for concussion

The following information is derived from the August 2014 NZR guidelines for concussion.

RECOGNISE | REMOVE | RECOVER | RETURN

After the minimum rest period AND if symptom free at rest a GRADUATED RETURN TO PLAY (GRTP) programme must be followed.

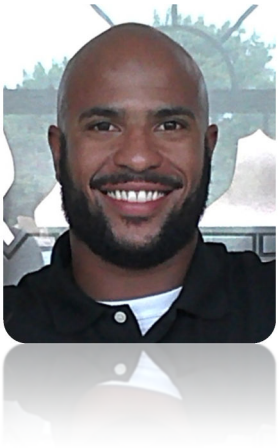
AGE	MIN. REST	GRTP**	MIN. TIMEOUT
U6-U19*	14 days	8 days	23 days
ADULT	14 days	6 days	21 days

* Players 18 years old and younger playing adult rugby must follow age grade guidelines

GRADUATED RETURN TO PLAY PLANNER		
DAY-BY-DAY (AT THE EARLIEST)	19 YEARS+	UNDER 19
DAY 1 Post Injury to DAY 14	Rest	Rest
DAY 15 & 16	Light exercise	Light exercise
DAY 17	Rugby exercise	Rugby exercise
DAY 18	Non-contact training drills	Rugby exercise
DAY 19	Full-contact training	Non-contact training drills
DAY 20	Full-contact training	Non-contact training drills
DAY 21	RETURN TO PLAY	Full-contact training
DAY 22		Full-contact training
DAY 23		RETURN TO PLAY

SPRINZ student rugby codes project updates

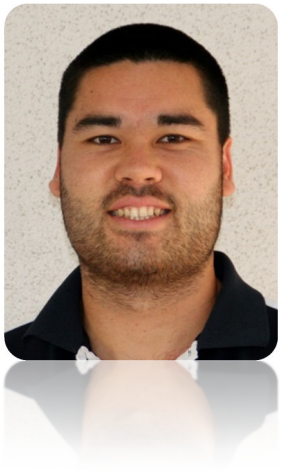
The role of strength, power, and physical properties of muscle in change of direction performance



Frank A. Bourgeois II

My research is focused on elucidating the interaction between strength and power and change of direction (COD), and exploring the physical properties of skeletal muscle and their possible influence on COD performance. Currently, I am conducting a literature review to assist in posing logical questions and constructing a sequence of investigations designed to answer these questions in a practical manner. My PGR9 is scheduled for July 2015.

Using a sample of elite athletes from a broad array of sports, the first set of explorations will be used to investigate the relationship bilateral and unilateral strength and power measured in multiple planes has with COD performance. In addition, kinetics and possibly kinematics will be evaluated during the power and COD assessments. Physical properties of interest are muscle architecture, muscle and joint stiffness, muscle and joint compliance (utilization of elastic energy), and titin expression. In accordance with observations in these examinations, a series of studies will be constructed to establish which factors are most important and when enhanced which qualities have the largest impact on COD performance.



Effects of tapering on power-force-velocity profiling and performance in elite rugby league

James de Lacey

Rugby league is a high intensity, collision sport where understanding strength, speed and power characteristics are imperative for strength and conditioning coaches to recognise the demands of the sport. Due to the high demands of elite rugby league, fatigue can impair on field performance. Implementing a taper can aid in reducing the effect of fatigue on performance. This thesis sought to gain insight into strength, speed and power differences between forwards and backs, tapering and physiological and performance changes and the effects of tapering on power-force-velocity profiling and jump performance in professional rugby league players. There is a lack of literature comparing strength, speed and power characteristics between forwards and backs in elite rugby league. Our findings showed that backs are faster over 10m (Effect Size=1.26) and 40m (ES=1.61) than forwards. Furthermore, backs produce greater relative horizontal force (ES=0.87) and power (ES=1.04) compared to forwards. Our findings suggest that developing horizontal force and power may potentially improve short sprint performance in rugby league players. On the basis of the literature review, significant improvements in physiological and performance measures occurred after a short tapering period. In the fourth chapter, a 21 day step taper was implemented leading into the in-season with 7 professional rugby league players. Measurements included vertical jump, performance and force-velocity-power variables. Our findings show positive changes in the power-force-velocity profile when implementing a step taper. A likely increase in F0 and a very likely increase in Pmax was found after a 21 day tapering period. Furthermore, jumping performance saw likely to most likely increases post taper. We suggest implementing a short step taper leading into the season where resistance training volume decreases to improve Pmax and performance.

Sleep, recovery and performance in elite athletes

Richard Swinbourne

My first study in 2013 focused on a qualitative assessment of sleep quality and quantity, recovery state and nutritional status in academy and elite athletes with a sample size n=182. Sleep data has been analysed and will form the discussion for my first paper, whilst the recovery state data (using a REST Q-76 questionnaire) will form a very interesting second paper, with variables of recovery and performance correlated to the sleep quality information. The number of elite athletes accessed during this study is unprecedented in NZ and will contribute strongly to the current body of literature at both a sleep and recovery level.

A quantitative assessment of sleep in elite Super rugby players was conducted during December 2013, as a part of a study titled 'What are the effects of a 4 week Super 15 rugby training programme on variables of sleep, immune response and markers of physical stress?' Alongside sleep data, salivary markers of physical stress and immune function were also collected.

An extension of the December study took place during January 2014, entitled 'What are the effects of a sleep hygiene education programme and sleep extension on variables of sleep, exercise adaptation and skill acquisition, immune response and markers of physical stress during a Super 15 rugby training programme?'. Alongside variables of sleep quality, physical stress and immune response to sleep extension during a pre-season training programme, this study aimed to answer the question of whether a sleep optimisation programme can change sleep related behaviour and improve sleep in elite athletes. Furthermore, the benefits of sleep extension with respect to reaction times, power and skill acquisition was examined. Study 3 was controlled. Both studies 2 and 3 were novel, and have not been explored before. Salivary hormone and immunology analysis has been completed with the assistance of Dr Deb Dulson at AUT.

The purpose of study 4, my final upcoming study, is to assess the efficacy of a nutritional intervention (tart cherry juice) on improving variables of sleep and physical recovery during a 3 week off season weight training block.

Influences on the physical demands of women's rugby sevens

Jan Reynecke

As of last week I have finalised all my data collection, GPS data along with individual and team match statistics were collected from 15 players for 3 IRB Women's World Series Tournaments.

Study 1 will be a descriptive analysis of the physical demands of match play comparing the differences between forwards vs backs and pool games vs Cup games. A summary of all GPS metrics match stats can be viewed in table 1.

Table 1: Summary of stats collected

GPS Metrics	Individual Stat	Team stats
Total distance walking (0–2 $m \cdot s^{-1}$) jogging (2–3.5 $m \cdot s^{-1}$) running (3.5–5 $m \cdot s^{-1}$) striding (5–6 $m \cdot s^{-1}$) sprinting (≥ 6 $m \cdot s^{-1}$)	Ball carry Ball into contact Pass Tackle Missed tackle Opposition ruck attended Own ruck attended Lineout Scrums	Game time Ball in play Time on defence Time on attack Ball in play cycles Recovery cycles

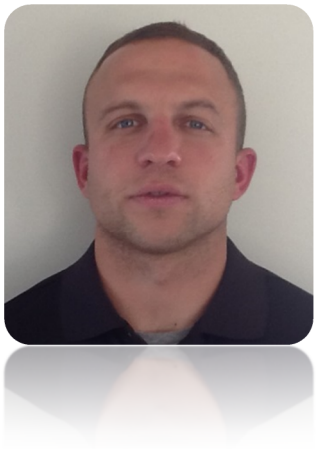
The study will follow a very similar design to that of Alex's Ross which will result in some direct comparisons which may be of some practical use. Study 2 will look at the influence of score differential on the same match statistics. 3 categories of score differential will be compared across the stats from table 1 (Group 1: <=7; Group 2: 8-20; Group 3: 21+). I aim to have all my statistics completed by the end of next month and both studies completed by the end of October.

Understanding and optimising vertical and horizontal force production for performance in team sport athletes

Caleb Dobbs

This doctoral thesis was undertaken to improve understanding concerning the assessment of power profiling and development of lower limb dynamic ability, particularly in the horizontal plane of movement. This has included a review of the current literature regarding lower limb power profiling and short term enhancement (STE) which provided direction for research undertaken in this thesis. They are as follow: Reliability of vertical and horizontal power profiling in well trained rugby players (Chapter 3), the relationship between vertical and horizontal jump variables and muscular performance in athletes (Chapter 4), the acute effect of STE on countermovement and drop jump performance (Chapter 5) and the effect of STE through contrast training on horizontal and vertical countermovement and drop jump performance (Chapter 6). The findings of this research are that many horizontal power profiling measures are reliable and are generally more strongly correlated to measures of functional performance than their horizontal counterparts. Furthermore, vertical preloading was found to cause STE in acute horizontal jump performance and training which induces acute STE was found to results in chronic improvements in dynamic ability. The aforementioned papers have been completed and are under review by various peer review journals.

The introduction and conclusion chapters have been written and are in the process of internal reviews with overseeing lecturers. In order to complete the doctoral these, the conclusion and introduction chapters must be finalized, literature reviews must be reworked and the thesis complied into a single document. This will be completed by September 30th 2014.



The relationship between physical characteristics and match performance in elite rugby sevens

Alex Ross

My research is focused on identifying the relationship between physical characteristics and match performance in rugby evens. I am just starting my third year and will commence my final study in October.

The purpose of the initial two investigations was to characterize the physical and technical demands of rugby sevens and to investigate whether differences exist between position groups, tournament rounds, and competition level. It was identified that the match demands of forwards and backs are mostly similar, as are the running demands of international and provincial matches, however provincial matches are characterized by an increase in handling errors and missed tackles. The third investigation sought to investigate differences in the physical characteristics of international and provincial rugby sevens players. This investigation revealed substantial differences between international and provincial players in speed, strength, power and aerobic endurance, which aids in understanding which physical characteristics may be

important for rugby sevens players. These three investigations informed the next study in which individual match performance indicators were investigated, with numerous match actions identified as having a substantial effect on the number of points scored and conceded. The relationship between these key match activities and physical characteristics was investigated in study five, with numerous moderate and large relationships were found between physical characteristics and match performance indicators. These relationships were further modelled to investigate the effect of an increase in performance in a physical characteristic on match performance. The final study will compare the effect of force-specific and velocity-specific training programs on important physical characteristics for rugby sevens players.

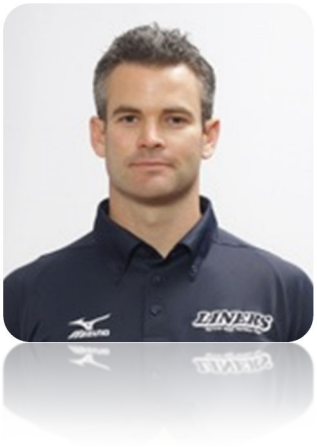
Isometric assessment and its relationship to dynamic performance in elite athletes

Albert Chang

Key focus:

i) Understanding the relationship between the isometric mid-thigh pull (IMTP) and various dynamic performances in elite athletes.
ii) The appropriate application of IMTP assessment in monitoring training progression and guiding program design in high performance environment
iii) The effect of isometric exercises training on various isometric and dynamic performances

The IMTP was first observed to have very high reliability, and very large to nearly perfect correlation to isometric squat (IS). The IMTP peak force (PF) production was five to ten percent lower than IS depending on the gripping method. Circadian rhythm appeared to have an effect on IMTP PF, however, appropriate warm-up minimizes such. The IMTP was also observed to have moderate to large correlations to body weight exercises, including maximal repetition of pull-up, and the PF of vertical jumps in ground based male team sport athletes. Interestingly, unlike the very large to nearly perfect correlations between IMTP PF and 1RM's in ground based athletes as shown in previous research, there was no significant correlations observed between IMTP PF and 1RM performances in rowers. The study on the training effects of isometric exercises in elite rugby sevens women is currently being written up.



Sprint-running acceleration training for team sport athletes based on individual force-velocity and power profiles

Kim Simperingham

Short sprint-running speed over 10-20 m (2-3 s) is very important for team sport athletes. This thesis will identify the best method(s) for assessing both short sprint ability and the mechanical capabilities of the lower limbs; and explore how these test results may be used to individualise and optimise sprint-training programming. Jump- and cycle-based testing, as well as run-based testing using radar, laser and certain treadmill technologies, enable athletes to be categorized as relatively force-dominant or relatively velocity-dominant based on their individual profiles for the mechanical capabilities of the lower limbs. It is theorized that force-dominant athletes will respond better to relatively light and fast physical training stimuli and that velocity-dominant athletes will respond better to relatively heavy and slow physical training stimuli. However it is first important to establish the reliability and validity of the advanced testing technologies and to better understand how the test results relate to sprint performance. The proposed series of eight studies will focus on the overarching thesis question: "Is the response to resistance- and sprint-training improved through differential training for force-dominant and velocity-

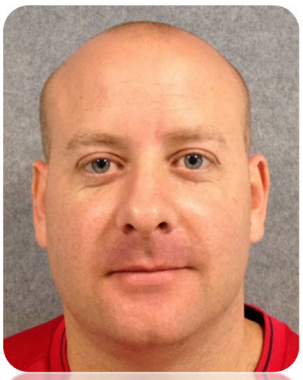
dominant team sport athletes?" The thesis findings will inform athletic testing and training procedures and potentially provide an athlete-specific method of determining the ideal training stimulus from the range of effective training techniques available.

Two longitudinal studies each over 15-weeks will be conducted to compare how the two groups of athletes respond to the different training stimuli over time, and whether individualizing training by targeting an athlete's area of relative strength or weakness is more effective. The members of the Auckland Rugby Union academy are the targeted participants for the first of these longitudinal studies beginning in November 2014.

Reliability and validity testing will take place in October 2014 with the members of the ProSport program at the Auckland Rugby Union.

The effects of accentuated eccentric loading during depth jumps on strength, power, speed and exercise induced muscle damage

Lee Bridgeman



My research is focused on accentuated eccentric loading during the drop jump exercise. Recently I have completed my PGR9 presentation and am currently in the process of submitting my PGR9 document. Once this is complete I will be working on my ethics and completing pilot testing prior to starting Study one in February 2015.

The initial study in this thesis will establish which drop heights and additional dumbbell loads during the eccentric portion of the exercise result in maximal jump height. As eccentric training has been reported to result in muscle damage the second study will investigate the effect of additional eccentric loading on markers of muscle damage. In a follow up study the same participants will after a two-week rest period complete the same drop jump protocol to establish if a previous bout of additional eccentric load drop jumps can confer a protective effect. The final study will investigate the effects of a six week additional eccentric load drop jump protocol on strength, power and speed in comparison to drop jump training with no additional load.

Does symmetry matter?

Scott R. Brown

The majority of manoeuvres that are performed in rugby (i.e. sidestepping, kicking, jumping) are executed on one leg yet our assessments of strength and power are typically performed on two (i.e. max squat, countermovement jump). What's more interesting is that New Zealand's rugby culture still follows the archaic "one size fits all" approach in our strength and conditioning and injury prevention programming. My PhD research evaluated a rugby union academy team during strength, balance, sprint and sidestep assessments do determine how effective a multi-component assessment strategy can be in determining deficits or asymmetries in movements most commonly seen in rugby. Associations between strength deficits or imbalances and sidestepping mechanics will be examined and recommendations for the use of individualised injury prevention programming will be created. The main goals of this research are 1) to determine if lower-extremity symmetry matters in rugby union athletes; 2) what are the initial steps that we can take to monitor and track these issues; and 3) will these steps positively impact lower-extremity injury risk without negatively effecting performance?

Book this in your diary

5 Dec 2014, 11am – 12 noon at AUT Millennium seminar room level 2.

Public seminar by Professor Meeuwisse on sport concussion consensus

Professor Willem (Winne) Meeuwisse MD

Professor, Sport Medicine Centre, Faculty of Kinesiology
Co-Chair, Sport Injury Prevention Research Centre
Leader, Brain Injury Initiative, Hotchkiss Brain Institute

Dr. Meeuwisse is a professor and physician at the University of Calgary Sport Medicine Centre. His medical responsibilities include varsity, Olympic and professional athletes. He is the Director of Sport Medicine for the Canadian Sport Centre Calgary and is also the Chair of the National Hockey League (NHL) Health Management Panel. He is engaged in population-based research on sport health screening, risk analysis, injury prediction and prevention, and is Co-Chair of the Sport Injury Prevention Research Centre in the Faculty of Kinesiology at the University of Calgary. His injury prevention focus is on Concussion in Sport. He is a founding member of the Concussion in Sport Group and Co-Chair of the 4th International Consensus Conference on Concussion in Sport (Zurich 2012). He is also the Leader of the Brain Injury Initiative of the Hotchkiss Brain Institute. He has 14 years publishing experience as Editor-in-Chief of the *Clinical Journal of Sport Medicine* (1998-2012).

The Sport Injury Prevention Research Centre (SIPRC) at the University of Calgary is a dynamic and interdisciplinary research environment that has been recognized by the International Olympic Committee in 2009 as one of four international research centres of excellence in Injury Prevention in Sport. This interdisciplinary research team has a unique focus on research in injury prevention in child and adolescent sport and recreation. The research activities are cross-translational, clinical and population research aimed at evidence-based practice in primary prevention and rehabilitation in sport medicine from a public health perspective. A priority of this interdisciplinary research team is in the area of prevention, early diagnosis and management of sport-related concussion in youth. As a full member of the Alberta Children's Hospital Research Institute for Child & Maternal Health and Hotchkiss Brain Institute, Dr. Meeuwisse is an active leader in interdisciplinary initiatives aligning with research priorities in the Faculty of Kinesiology and Medicine.