



FSEM / WFATT Conference 2014

The Faculty of Sports and Exercise Medicine
11th Annual Scientific Conference &
The World Federation of Athletic Training and
Therapy World Congress 2014

ABSTRACT BOOK

The Sporting Hip, Groin and Hamstring:
A Complete Picture

Thursday, Friday & Saturday
4th - 6th September 2014

The Helix, Dublin City University, Ireland

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DR NICK MAHONY

CHAIR FSEM Annual Scientific Committee

On behalf of the organising committee I would like to thank all those delegates who have submitted an abstract to the 11th Annual Scientific Conference of the FSEM in Ireland and the WFATT World Congress, co-hosted by Athletic Rehabilitation and Therapy Ireland and Dublin City University.

The number and quality of abstract submissions in four main thematic areas continue to grow. We have received abstract submissions from Athletic Training and Rehabilitation Therapists, Biomechanists, Chartered Physiotherapists, and Doctors from a variety specialities. All these disciplines have similar goals and so hopefully the cross pollination of research ideas and experiences, in oral and poster formats will foster further mutual understanding and collaboration across our varied disciplines.

In 2012 the FSEM conference committee took the bold step of introducing parallel scientific sessions to give all our delegates the opportunity to present their research work and clinical experiences in an oral format. Again this year all those who requested an oral presentation have been afforded the opportunity to make at least one presentation to an audience of their peers. The overwhelming number of submissions has also necessitated that main and parallel scientific sessions be extended in both time; and in particular in SEM and ITR, by the addition of two extra venues for presentation on Saturday.

Friday afternoon is again taken up by our main thematic session, where the programme content was determined by prior blinded editorial review. The number of talks in each session was based on the number of submissions in each category and two independent judges will judge for the best oral scientific and clinical case presentation in the main session. In addition on Saturday the best oral scientific presentation from each venue will also receive a prize.

As well as abstracts submitted for oral presentation we will have over 35 poster presentations, and I would strongly encourage our delegates to follow our poster judges on Friday lunchtime as they listen to 2 minute poster presentations and questions in the adjudicated poster session. Our judges will come together again on Saturday to decide on those shortlisted on Friday for the poster prize.

Once again on behalf of the committee I would like to thank all you who have put together an abstract for oral or poster presentation, and support of the research content of the meeting.

A handwritten signature in black ink, appearing to read 'Nick Mahony', written in a cursive style.

SEM 36: Lower trapezius muscle thickness and strength in patients with and without scapular dyskinesis.*Eberman L, Van Deusen A, Kahanov L & Demchak T**Indiana State University, Terre Haute, Indiana, United States.*

Introduction: Dyskinesis has been linked to deficits in muscular strength and neuromuscular control of the scapular stabilizers; however, the role of the lower trapezius (LT) strength in scapular dyskinesis is not well understood. We used an ex-post-facto descriptive design to measure the relationships and identify differences among varying levels of scapular dyskinesis on LT muscle thickness and strength. **Methods:** We evaluated scapular dyskinesis using the clinical visualization technique in 50 participants (age=25±6yr; mass=71.7±13.2kg; height=173.5±10.2cm; males=23/50, 46%, females=27/50, 54%; right-handed=48/50, 96%, left-handed=2/50, 4%). Each scapula was classified as normal, subtle or obviously dyskinetic. Participants lifted a 1.4kg (mass<68kg) or 2.3kg (mass>68kg) weight overhead in flexion (5 repetitions) and abduction (5 repetitions), while a trained clinician observed for dysrhythmia or scapular winging. We evaluated strength with a hand-held dynamometer (microFET2, Hoggan Scientific, ±1%) during a LT manual muscle test at the same time measuring muscle thickness measurement of muscle thickness. We used separate one-way ANOVAs to examine the size and strength of the LT comparing over three levels of scapular dyskinesis in the dominant limb (DL). We used a Spearman rho correlation to determine the relationship between scapular dyskinesis, muscle strength, and muscle thickness in the DL. **Results:** We did not identify any significant differences between DL levels of scapular dyskinesis on strength ($F_{2,49}=0.596$, $P=0.555$, $1-\beta=0.93$) and thickness variables ($F_{2,48}=0.714$, $P=0.495$, $1-\beta=0.51$). We identified no significant correlation between DL scapular dyskinesis and strength (DL Spearman's rho= -0.160, $P=0.266$) or thickness (DL Spearman's rho=-0.175). We did identify a significant, strong relationship between DL strength and thickness (Spearman's rho=0.706, $P<0.001$). **Discussion:** Our findings suggest that LT strength and thickness have little impact on the presence of scapular dyskinesis. As such, neuromuscular control should be studied to better understand the multifactorial issue of scapular dyskinesis.

SEM 42 Changes in three-dimensional cutting biomechanics following athletic groin pain rehabilitation*Marshall B, Franklyn-Miller A, Moran K, & Falvey E.**Sports Surgery Clinic, Dublin, Ireland.*

Introduction: Athletic groin pain (AGP) is associated with the dynamic movements of acceleration, deceleration and sudden direction change (cutting). At present, the biomechanical factors associated with AGP are not well understood. Study Aims: To compare three-dimensional cutting mechanics prior to and following AGP rehabilitation. **Methods:** Forty recreational field sports players diagnosed with chronic athletic groin pain were recruited. Standard 3D motion capture techniques were used to examine biomechanics in an acute 75° cut before and after rehabilitation. An analysis of characterising phases approach to data analysis was adopted to identify significant differences ($P<0.05$) in cutting mechanics. **Results:** Following rehabilitation, participants tended to lean more toward the direction of the cut than they did prior to rehabilitation: there was significantly greater ($P<0.05$) contralateral pelvic drop, contralateral pelvis transverse rotation, and a greater contralateral thorax side flexion following rehab. In addition, the ankle was more dorsi-flexed throughout the movement while the knee and hip were more extended ($P<0.05$). Participants produced significantly smaller concentric hip abductor moments following rehab while external rotator moments were greater ($P<0.05$). **Discussion:** AGP patients assumed a more "lean in" than "lean out" pelvis and thorax position while cutting following rehabilitation. This apparently more effective body conformation appears to have altered the force generation characteristics of the cut where greater external rotation moments at the hip are generated but the reliance on hip abductor moments is reduced. In addition it could also be suggested that there is greater posterior chain utilisation following rehabilitation as evidenced by a more dorsi-flexed ankle in conjunction with a more extended knee. As far as the authors are aware this is the first study to establish an association between 3D cutting mechanics and AGP.

SEM 46 Movement based rehabilitation of Athletic Groin Pain: A Cohort study*King E, Marshall B, Franklyn-Miller A, & Falvey E.**Sports Surgery Clinic, Dublin, Ireland*

Introduction: The underlying mechanism of athletic groin pain (AGP) is poorly understood but the authors recognise the importance of planar stability of the pelvis and torso provided by the oblique and transverse muscles and segmental stiffness. Study aims: To examine the effect of a rehabilitation intervention designed to

correct control deficits when cutting and landing. **Methods:** Forty recreational field sports players diagnosed with AGP were recruited (mean \pm SD: age, 24.6 \pm 5.1 years; height, 181.1 \pm 5.4 cm; mass, 81.9 \pm 9.1 kg; time with groin pain, 63.5 \pm 10.6 weeks). Clinical examination by a Consultant Sports Physician and Senior Physiotherapist, completion of patient reported outcome measure-HAGOS, MRI imaging and 3D motion analysis of a hurdle hop and cut was undertaken. **Results:** Initial HAGOS was 63.9 (SD 16.3) and on return to play was 83.3 (SD 10.2). Time spent in rehabilitation was based on three phases Level 1 2.6 (SD 14.1) weeks, Level 2 3.2 (12.2) weeks and Level 3 3.9 (13.4) weeks. Overall time to return to Play was 9.8 (SD 22.8) weeks. A reduction in anterior pelvic tilt during the hurdle hop and side lean of the torso toward the direction of ultimate travel in the cut were the salient findings ($P < 0.05$). **Discussion:** Adductor strength has been the classical focus of non-surgical management of groin pain and typical rehabilitation time is approximately 4 months. This is the first work focusing on multi-planar pelvis control, progressing through to linear and multi directional running mechanics focussing on torso, pelvic and lower limb efficiency, in the management of AGP. The data suggests this focus on high speed movement deficits facilitates expedited return to play.

SEM 47 A comparison of asymmetry in athletic groin pain patients and elite rugby union players using analysis of characterising phases

Gore S, Richter C, Franklyn-Miller A, & Moran K.

Dublin City University, Sports Surgery Clinic, Insight Centre for Data Analytics, Dublin, Ireland

Introduction: Inter limb asymmetry may be of relevance in the investigation of athletic groin pain (AGP) as it is a suggested risk factor for other lower extremity injuries. To date, no studies have investigated if this is the case. The aim of this study is to compare asymmetry in rugby union (RU) players to that of AGP patients. **Methods:** 15 field sports players with AGP (age, 25.6 \pm 5.3 yr; height, 181.4 \pm 6.5 cm; mass, 82.7 \pm 11.8 kg; time with AGP, 50.8 \pm 70.2 weeks) and 15 elite injury free RU players, were recruited (age 20.4 \pm 1.0 years; height 186.2 \pm 7.6 cm; mass 98.4 \pm 9.9 kg). Testing involved three trials on each leg for a running cut (75°). Eight infra-red cameras (Vicon -Bonita B10, UK), synchronized with two force platforms (AMTI, BP400600, USA) collected data using Plug in Gait marker locations (Vicon, UK). Marker and force data were filtered using a fourth order Butterworth filter at 15 Hz. Hip, pelvis angles and hip moment waveforms were manually landmark registered (using dynamical time warping) or phase shift registered. Subsequently, normalized asymmetry was calculated: $Asym(t) = [(max(t) + \delta) - (min(t) + \delta)] / (max(t) - \delta)$. The registered left and right mean curves were also shifted by the minimum value within both curves (δ), making all values positive. An independent t-test ($\alpha=0.05$) examined subject scores generated during an analysis of characterising phases. Key phases were identified using a VARIMAX rotation principal component. **Results/Discussion:** The primary finding was that in general, the AGP group displayed significantly greater inter limb asymmetries in hip ab/adduction moments compared with the RU group ($P < 0.01$). Whilst it is unknown if these asymmetries have a causative relationship with AGP, asymmetries are generally considered undesirable in sports injury literature. As such, an aspect of rehabilitation for AGP should focus on reducing asymmetric hip ab/adduction moments.

SEM 68 To investigate the correlation between distance jump performance and landing kinematics during a distance jump assessment following ACL reconstruction

McEntee B, Marshall B, Falvey E, Franklyn-Miller A.

Sports Surgery Clinic, Dublin, Ireland

Introduction: ACL injury is associated with the dynamic movements of jumping, landing, deceleration and change of direction. Collectively, landing kinematics, muscle strength, power development and load absorption play an important role in functional joint stability. Reducing injury risk during cutting, jumping and landing requires optimal performance in each of these areas and should all be considered in return to play (RTP) decision making. While it is widely recognised that isokinetic strength and power performance are primary objective markers when assessing readiness to RTP following ACL injury, quality of landing kinematics is often overlooked. **Methods:** 30 male GAA athletes were recruited following ACL reconstruction. Movement control was ranked on a scale of five to zero. One point was deducted for each of the following: loss of knee, pelvic and trunk control, poor load absorption and inability to maintain balance on landing for greater than one second. Participants were grouped into a 'poor control' group (0-2 score) and a 'good control' group (>3 score). Single Leg Jump distance was obtained from the horizontal distance travelled by a toe marker as calculated by a high speed motion capture system (Vicon). An independent measures t-test ($\alpha=0.05$) was used to examine differences in jump distance between groups. **Results:** 16 individuals were categorised as having poor control and 14 individuals as having good control. There was no significant difference ($P=0.79$) in jump distance between the groups (171.3 \pm 25.0cm vs. 168.8 \pm 23.8cm, respectively). **Discussion:** Our study demonstrates

the lack of correlation between single leg jump distance and landing kinematics. This suggests the need to evaluate kinematics in RTP and not base our decisions solely on strength and power performance.

SEM 69 An observational survey of joggers in South Dublin

Hooper C

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Introduction: Jogging is the tenth most popular form of exercise in Ireland, excluding walking. The present study was undertaken to determine the relative proportion of male and female joggers and to identify gender differences in selected parameters. **Methods:** Joggers were observed in South Dublin during a 24 month period from 01 April 2011. Organised groups were excluded. The gender of each jogger was recorded as was the day and time. The use of earphones, drinks and high visibility clothing was noted. **Results:** 55,726 joggers were observed. 60% (n=3,426) were male and 40% female (n=2,300). The highest proportion of female joggers (45%) was seen at out-of-hours times during weekdays. 82% of male joggers and 78% of female joggers ran alone. Same-gender partnerships (male 12%; female 14%) were more frequent among the remainder. The carrying of drinks was negligible. The wearing of high visibility clothing was low (male 6%, female 7%). 28% of female joggers, but only 12% of males, wore earphones. **Conclusions:** These results confirm the greater participation of males in sport and exercise reported previously. The social relationships of male and female joggers were similar. The low usage of high visibility clothing by both genders, especially at night, and the high use of earphones by female joggers have safety implications for joggers and others.

SEM 83 An analysis of performance differences, knee joint kinetics and kinematics between bladed and moulded football boots during cutting

O'Reilly E, Marshall B, Falvey E, & Franklyn-Miller A

Sports Medicine Department, Sports Surgery Clinic, Santry Demesne, Dublin, Ireland

Introduction: Footwear selection is an important consideration in aiding performance in sport. The current study aimed to evaluate an athlete's cutting time and performance in moulded boots (MB) and bladed boots (BB). A secondary aim was to analyse differences in knee joint kinetics and kinematics between each boot during a cut. **Methods:** 23 elite GAA players performed an approximate 75° cut in the MB and the BB on an artificial grass surface. Joint kinetics and kinematics were collected at 200Hz using eight Vicon Bonita cameras and two AMTI force plates. Time to complete the cut was measured using timing gates (Smart Speed, Australia). Testing was quasi-randomised for the order of testing between boots. **Results:** Peak knee flexion angles were significantly greater ($P<0.05$) in the BB ($67.1^\circ \pm 6.6^\circ$) during the cut. Significantly ($P<0.05$) greater vertical ground reaction forces were recorded in the MB in the cut: MB ($18.6 \pm 2.2 \text{ N.kg}^{-1}$) versus BB ($17.8 \pm 2.1 \text{ N.kg}^{-1}$). Total contact time on the force plate was significantly less ($P<0.05$) in the MB (0.177 s) when compared with the BB (0.196 s). The total time to complete the cut was significantly less ($P<0.01$), with athletes taking less time ($3.65 \pm 0.2 \text{ s}$) in the MB when compared with BB ($3.74 \pm 0.2 \text{ s}$). **Discussion:** Neither boot was associated with significantly increased knee joint moments in this study, although there was increased peak knee flexion angles in the bladed boot. There were no differences between boots in knee transverse or coronal plane kinematics or kinetics, factors that have previously been linked to increasing the risk of serious knee injury. The decreased times associated with the MB may indicate that these boots are a better selection on this type of artificial surface from a performance perspective in multidirectional running sports.

SEM 84 An analysis of hip and knee joint kinematics and kinetics during a drop landing in bladed and moulded football boots

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Introduction: Footwear type has been debated as a possible risk factor in increasing injury incidence in sport. The current study aimed to assess the differences in hip and knee joint kinetics and kinematics between moulded boots (MB) and bladed boots (BB) during a drop landing. **Methods:** 23 elite GAA players performed a drop landing in the MB and the BB on an artificial grass surface. Joint kinetics and kinematics were collected at 200Hz using eight Vicon Bonita cameras and two AMTI force plates. Testing was quasi-randomised for the order of testing. **Results:** Hip flexion was significantly greater ($P=0.01$) in the BB ($54.1^\circ \pm 11.6^\circ$) versus the MB ($52.1^\circ \pm 11.1^\circ$) during the drop landing. Significantly greater ($P=0.02$) vertical ground reaction forces were recorded in the MB ($34.0 \pm 4.8 \text{ N.kg}^{-1}$) when compared with the BB ($34.8 \pm 4.8 \text{ N.kg}^{-1}$) during the drop landing. A significant ($P<0.01$) negative correlation was found between peak hip flexion and vertical ground reaction force in both boot the BB ($r = -0.50$), and in the MB ($r = -0.51$). **Discussion:** Athletes demonstrated decreases in

vertical ground reaction forces while wearing the BB. Decreased ground reaction forces are desirable in landing tasks from an injury prevention point of view. This contrasts with the stiffer landing and increased ground reaction forces that contribute to enhancing athletic performance in stretch-shortening cyclic movements such as repeated jumping. The MB displayed decreased peak hip flexion angles ($P=0.01$) and greater vertical ground reaction forces ($P=0.02$) which may indicate that the MB is more efficient in terms of performance parameters.

SEM 85 Relationship between the frequency of football practice during skeletal growth and the presence of a cam deformity in adult elite football players

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Introduction: Cam deformity is most likely a bony adaptation in response to high impact sports practice during skeletal growth and can therefore possibly be prevented. The objective was to study whether there is a dose-response relationship between the frequency of football practice during skeletal growth and the presence of a cam deformity in adulthood. **Methods:** Professional elite footballers from two Dutch football clubs were invited to participate. Standardized anteroposterior and frog-leg lateral radiographs were obtained during the seasonal screening. A cam deformity was quantified by an alpha angle $>60^\circ$ in either view. Data on age in relation to frequency of football loading were collected by standardized questionnaires. The differences in prevalence per hip between groups were calculated by logistic regression with generalized estimating equations. **Results:** 63 players participated revealing 126 hips for analysis. The mean(\pm SD) age was 23.1(\pm 4.2) years (range 18.2–38.4 years). All were skeletally mature. The prevalence of a cam deformity on the frog-leg view was lower in footballers that started playing football frequently (>5 times/week) from the age of 12 years or older (40.2%, $n=82$) than in footballers who started playing football frequently before the age of 12 years (63.6%, $n=44$, $P=0.042$). **Conclusion:** The results show that in players who report starting frequent football practice at an early age a higher prevalence of Cam lesions is found. This suggests a dose response relationship of football during skeletal growth and the development of a cam deformity, which should be confirmed in future prospective studies.

SEM 91 Comparison of frequency of practices implemented by athletic training professionals across four countries

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Introduction: Athletic training has been globalized; however, information on how it is practiced from country to country is scarce. This study aims to identify the specific practice patterns of athletic training tasks performed by athletic training professionals in various countries by comparing the practice frequency of athletic training tasks. **Methods:** We used data from the Global Practice Analysis Survey collected by the Board of Certification, Inc. (BOC) in the United States and the Japan Sports Association (JASA) in which the practice frequency was rated between 0 (rarely) and 3 (repetitively) for each 24 athletic training tasks spread across four domains: Assessment, Intervention, Administration, and Education. Data for 813 athletic training professionals from four countries (United States: 197; Canada: 110; Japan: 474; Ireland: 32) were used. Total scores in each domain were analysed by ANOM with Transformed Ranks, and mean frequency ratings in each task were calculated to find the most to least frequently performed tasks for each country. **Results:** Comparing group means (Intervention: 0.793; Administration: 0.793), US athletic trainers had significantly higher mean transformed ranks for both Intervention (0.950, upper decision limit 0.945) and Administration (1.095, upper decision limit 0.946), while Japan had a lower mean only in Administration (0.729, lower decision limit: 0.760). There were no statistically significant deviations from group means observed in Canada or Ireland. The highest- and lowest-frequency rating tasks were the same in all the countries except Japan, and three of the five highest-rated tasks for each country were common among all studied countries. **Discussion:** US athletic trainers had a unique pattern of practice with higher frequency in tasks in the Intervention and Administration domains. However, practice frequency ranks were similar among studied countries, and hence, commonalities may exist in at least some realms in athletic training tasks among different countries.

SEM 105 Reproducibility and reliability of SCAT3 and King Devick concussion assessment tools in junior rugby players - preliminary results*Daly F, Mahony N & Donne B**Human Performance Laboratory, Anatomy Dept., Watt's Building, Trinity College Dublin, Ireland*

Introduction: The validity of two common neuropsychological tests, SCAT3 and King-Devick (KD), used in assessment and monitoring of concussion is not well established. Recent research also suggests elements of SCAT3 scoring are open to interpretation unlike KD which has well defined scoring systems. The aim of this study was to compare reliability of the widely used SCAT3 to the KD which is purportedly less open to error in measurement. **Methods:** Under-18 male Irish amateur rugby players (n=22) from Dublin were recruited following parental and individual consent. At pre-season training camp each player underwent repeat SCAT3 and KD tests. Tests were conducted in randomised order, 5 days apart (4 tests per individual), at the same time of day; and with the same pre-test routine following an easy training day. Preliminary analysis of repeat test data included; intra-class correlation (ICC) for repeatability; scedasticity and systematic bias (Bland Altman), and relative reliability was expressed as percentage technical error of measurement (%TEM). **Results:** Initial ICC was 0.58 and 0.51 for SCAT3 and KD, respectively. Bland Altman plot indicated a small positive bias in KD but not SCAT3; and %TEM for SCAT3 (~17%) was higher than for KD (~9%). **Discussion:** Preliminary results indicate that KD, although less repeatable and exhibiting a possible learning effect, may be a more reliable concussion assessment tool than SCAT3. However, %TEM of both assessment tools is currently above recommended levels (<5%) that would make either test valid for clinical application. Further evaluation with n=30-40 players is currently underway to further evaluate initial findings.

SEM 108 Chronic Exertional Calf Pain: A Case series of Gait retraining to alleviate symptoms*Foster J, Breen D, Falvey E & Franklyn-Miller A**Department of Sports Medicine, Sports Surgery Clinic, Santry Demesne, Dublin, Ireland*

Introduction: Exertional calf pain is a common complaint affecting recreational runners often leading to running cessation. There is often no acute event and imaging such as MRI excludes any structural pathology. Initiation of running causes a cramp-like tightness in the calf. This builds to a crescendo. Pain then settles rapidly with rest. Functional popliteal artery entrapment (F-PAES) and Posterior Compartment Syndrome are, among other conditions, often offered as diagnoses for this condition, with surgery as the only treatment. The authors propose a new diagnosis of Posterior Biomechanical Overload Syndrome (PBOS) which may be successfully managed by altering running kinematics. **Methods:** We examined the clinical outcome and kinematic changes of 8 patients referred with calf pain. A gait retraining program was designed using coaching cues and immediate video feedback to reduce overload of the superficial posterior compartment muscles. A patient reported outcome tool- EILP Questionnaire, improvement in running distance and 2D kinematic changes were recorded following a 6 week running re-education program. **Results:** At six week follow up after an average of three visits there was a significant reduction of symptoms as measured using the EILP Questionnaire. 5 patients were running pain-free for 30 minutes, 2 patients were able to run for 30 minutes with mild non-limiting symptoms. Statistically significant changes were noted in tibial angle and foot inclination at foot strike, dorsiflexion at mid stance, stride length and cadence. **Conclusions:** Our series provides evidence that coaching cues can be effectively used to alter running technique and that calf pain can be alleviated by kinematic changes in running gait.

SEM 109 Active video game play blunts decreases in enjoyment during exercise and results in moderate-to-vigorous physical activity*Monedero J, O'Gorman D**School of Health and Human Performance, Dublin City University, Dublin, Ireland*

Introduction: While physical activity (PA) exerts beneficial effects on health and chronic disease prevention, worldwide PA levels remain low and PA interventions have high dropout rates. Participants that have positive affective judgements towards the exercise are more likely to adhere to it than if they are neutral towards the activity or even dislike it. The aim of this study was to compare the physiological, psychological and affect responses to two types of active video games (AVGs) and moderate intensity and self-selected intensity exercise. **Methods:** Twenty-three sedentary subjects (12 women and 11 men) reported to the laboratories on 6 separate days. Maximal oxygen uptake (VO₂max) was measured during a treadmill test and subjects learnt how to play the two AVGs used. Subjects took part in 4- 1 hour randomised trials: self-selected intensity (SS), 55% VO₂max, entertainment-themed video game (ETVG) and the fitness-themed video game (FTVG). Physiological, psychological and affect outcomes were recorded before, during and after the exercise part of

the trials. **Results:** SS resulted in the highest %VO₂R (68.3±13.9) and rates of energy expenditure (REE) (10.3±3.1 kcal.min⁻¹) of all conditions. 55% VO₂R and FTVG resulted in higher %VO₂R and REE than ETVG. No differences were found in %heart rate reserve (HRR) between SS and FTVG, 66.9±12.5% and 67.1±6% respectively. AVGs resulted in higher enjoyment ratings than both exercise conditions. ETVG resulted in the highest psychological well-being (PWB). **Conclusions:** The main findings are that AVG play can result in exercise intensities that induce health benefits and enjoyment ratings are higher while playing these games than while doing conventional exercise. ETVG also resulted in the highest PWB ratings of all conditions. Affective states during exercise are an important element in determining exercise adherence. These results support the use of AVG technology to increase adult physical activity.

SEM 118 25-hydroxyvitamin D3 status in anterior cruciate ligament reconstruction patients

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Introduction: Vitamin D is mainly derived from exposure to ultra violet light and less so from dietary intake. Reduced sunlight exposure and 25-hydroxyvitamin D₃ (25(OH)D₃) levels have been shown to be associated with decreased knee cartilage loss. We are unaware of any study which has looked at a cohort of patients undergoing an anterior cruciate ligament reconstruction. **Methods:** This is a single centred study of case-controlled design to determine the prevalence of insufficient/deficient 25(OH)D₃ levels in patients attending for anterior cruciate reconstruction (ACLR). All ACLR subjects over the course of a calendar year had their 25(OH)D₃ levels assessed while in hospital. Data were categorised as normal (above 75 nmol/L), insufficient or deficient (below 25 nmol/L). 50 patients had their Vitamin D levels assessed. 11 (22%) were female. **Results:** Five (9%) of subjects had levels of Vitamin D above 75nmol/L, nine (18%) of subjects were in the deficient category. The remainders were in the insufficient range. **Conclusion:** The vast majority of the ACLR population tested had insufficient or deficient levels of 25(OH)D₃ despite being taken over the course of a calendar year.

SEM 131 A prospective study of injuries at an international tri nations tag rugby tournament Limerick, 11th July 2014 (Ireland vs Australia vs Great Britain)

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Introduction: Tag Rugby is a popular sport in Ireland with over 10,000 registered players. Despite the high levels of participation, little data is available about tag rugby injuries. Epidemiological information is needed before injury prevention strategies can be implemented. The aim of this study was to prospectively record injuries that occurred in international tag players while competing in the Tri Nations tournament. **Methods:** All injuries occurring in international tag players were recorded contemporaneously. Information collected was analysed by lead investigator. Players were assigned unique codes for confidentiality. Informed consent was obtained. **Results:** 73 injuries were reported during the tournament (n=142 players), majority in females (n=46). Preliminary data analysis indicates most commonly injured body parts were thigh/knee (n=15), thumb (n=13) and lower back/pelvis (n=12). Most common injury in males was thumb and thigh/knee (n=9 in each case). In females, most common injury was thumb (n=10). **Conclusions:** Strategies to reduce injuries should be based on an audit of the problem. This is the first study to prospectively collect injury data from elite international tag rugby players. When the most common injuries sustained in tag rugby are ascertained, preventative measures can be put in place. Injuries in tag rugby are common. Females are more at risk of injury. Going forward, rules may need to be more strongly enforced or adapted to reduce injury risk in tag rugby.

SEM 138 A prospective study of injuries in the FAI emerging talent program 2013-14

O' Neill LA, Dunlevy C, Lambe P, & Byrne A

Football Association of Ireland, Dublin, Ireland

Introduction: The Emerging Talent Program (ETP) provides professional soccer coaching to elite adolescent players in Ireland. We prospectively collected injury data from ETP centres. Soccer injury leads to recurrence and impacts on a players health and performance. Strategies to reduce injuries should be based on an audit of the problem. There is no prospective data from Irish soccer. **Methods:** All injuries occurring in male underage players at the 2 ETP centres during 2013/14 were recorded contemporaneously. Information collected was sent to the lead investigators for analysis. Players were assigned unique codes for confidentiality. **Results:** 90 players participated. Average age was 15.5 years. There were 118 documented injuries. Exposure time (n=47) to sport on week of injury was 4.9 hours (± 1.75 hours). The majority, 76.5%, occurred during club play. Only

10.2% occurred at the ETP centres. 80% were new injuries. Most (65%) were non-contact injuries. Most were muscle injuries (44.6%), mainly thigh (27%) and hip/groin (17.4%). Midfielders were most injury prone (46%). Forty-two percent of injuries resulted in loss of 8-28 days play. Similar to American data, midfielders sustained most injuries. Muscle injuries were more common. **Conclusion:** Injury profiles of Irish elite players differ to those internationally, the main difference being Irish players sustained more muscle injuries. The ETP should expand injury surveillance to all 12 centres. This will allow more data to be collected, leading to development of injury prevention strategies specific to Irish soccer.

SEM139 Neuro-functional training programme: an innovative service development where suitable individuals with a neurological condition can exercise optimally and safely in a non-clinical community gym setting.

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Introduction: Primary Care Physiotherapists initiative aimed at optimising exercise participation thereby enhancing long term self-management and preventing secondary complications in this population. This is a collaborative initiative with a community based gym and staff. Currently the neurological population face barriers to exercise participation in the community. The purpose of this service development is to address this gap. **Methods:** 'Neuro-Functional Training Programme' (NFTP) is a chartered physiotherapy-led exercise programme for individuals with a neurological condition. This 12 week programme takes place in Leisure World Gym, Cork. The HSE physiotherapists assess the patient and devise an exercise programme which is then supervised by gym instructors. The programme includes a six and twelve week review to allow progression and/or amendment as required. Two HSE physiotherapists attend weekly. Safety Categories, Neuro-Functional Screening Forms and information packs have been devised. Tutorials had been given to the gym instructors on the presenting features of neurological conditions. All these measures ensure the programme runs effectively and safely. **Results:** Participation to date has been excellent with 2,126 attendances on the NFTP from March 2013 to date. 75% are continuing with their prescribed exercise programme in the NFTP on a weekly basis. Anecdotal evidence from feedback questionnaires include increased energy, improved mood, reduced stiffness, improved ADLs at home and improvements in pain. **Conclusion:** The above programme is allowing people with a neurological condition to exercise by creating self-efficacy and by breaking down barriers for exercise. This is a novel service provision model and we are hoping that other physiotherapists can learn from this model of care. We are currently working with UL to formally evaluate this positive service development.

SEM 140 Use of NSAIDs in senior club Gaelic footballers: examination of rates of consumption, reasons for use and knowledge of potentially negative side effects

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Introduction: Consumption of NSAIDs in sport has seen widely varying reports from as low as 13.4% to 92.6% on both a professional and amateur levels across both field and track sports. Often athletes experiencing injury rely on taking NSAID's instead of taking appropriate time to recuperate and rehabilitate. The percentage consumption rate in soccer falls between 17.3% and 92.6%. Reasons behind this ranged from pain prevention, to injury treatment to unspecified. Of those studies who did seek to ascertain the knowledge of potential effects & side effects the results showed a lack of understanding around the compounds being taken. **Methods:** A prospective cohort study via a 26 point questionnaire was administered to 283 amateur male Gaelic football players (26.1 ± 5.4 yr) in mid championship 2013 competition from 12 senior club football teams. **Results:** 34.9% (n=99) of the athletes admitted to using NSAID's during the current season. Of these 14.8% (n=42) admitted to using them in the 3 days before their last championship match, 10.25% (n=29) on the day of their last championship match and 17.7% (n=8) in the three days after their last championship match. Among those who consumed the NSAID 45% (n=28) of them were self-prescribed without professional medical supervision. The main reason given for consumption was injury (35.7%) and pain treatment (33.8%). Apart from gastro-intestinal discomfort and an awareness of negative interactions with alcohol most of the athletes were unaware of potential negative side effects associated with general NSAID consumption. **Conclusion:** The investigation found a relatively low consumption of NSAID's, poor awareness of potential negative side effects and a high rate of self- prescription. It is suggested that any education protocol would be more effective if it was instigated at club level rather than relying on effective dissemination from governing body.

SEM 143 Cardiorespiratory fitness, risk factors and subclinical atherosclerosis in adolescent males*Sheridan S, O'Connor P, & Moyna N**Dublin City University, Dublin, Ireland*

Introduction: The purpose of this study was to compare selected cardiovascular disease (CVD) risk factors, carotid intima media thickness (cIMT) and endothelial function (EF) in adolescent boys with low cardiorespiratory fitness (CRF) and high CRF. **Methods:** A total of 9 low fit (15.9 ± 0.6 yr) and 14 high fit (15.86 ± 0.37 yr) healthy boys were randomly selected from a total of 228 boys who underwent aerobic fitness screening using a 20 metre shuttle run test and heart rate monitoring. During a single visit to the Vascular Health Research Unit, a blood sample was drawn, body composition was assessed, and cIMT, EF and VO₂max were measured. **Results:** Body mass index (BMI), % body fat, systolic blood pressure (SBP), diastolic blood pressure (DBP), fasting glucose, triglycerides and non-high density lipoprotein cholesterol (HDL-C) were significantly higher in the low than the high CRF group. cIMT was significantly higher in the low than the high CRF group. Endothelial dependent dilation (EDD) was significantly lower in adolescents with low CRF ($7.66 \pm 1.28\%$) than with high CRF ($13.90 \pm 2.88\%$). There was no significant difference in endothelial independent dilation (EID) between the two groups. There was a significant relation between VO₂max and EDD ($r = 0.86$; $P < 0.001$). There was a significant relation between VO₂max and far ($r = -0.77$; $P < 0.001$) right wall cIMT, and between VO₂max and far ($r = -0.74$; $P < 0.001$) left wall cIMT. **Conclusion:** There was a significant difference in BMI, % body fat, SBP, DBP, TG, glucose, non-HDL, cIMT and EF between adolescent boys with low and high CRF. Low levels of CRF are associated with subclinical atherosclerosis among adolescent boys.

ITR 6 Hip and shoulder rotational range of motion in youth baseball pitchers*Oliver G, Weimar W**Auburn University, Auburn, USA*

Introduction: Range of motion (ROM) has long been suspected as contributing to injury in baseball pitchers, however all previous research has focused on the ROM of collegiate and professional pitchers particularly only of the upper extremity. Therefore, it was the objective of this study to measure and evaluate the correlation between bilateral hip and throwing shoulder rotation ROM in youth baseball pitchers. **Methods:** Twenty-six youth baseball players (11.3 ± 1.0 yr; 152.4 ± 9.0 cm; 47.5 ± 11.3 kg), with no history of injury, participated. Bilateral hip and throwing shoulder rotation passive range of motion (PROM) were measured. **Results:** There were no significant side-to-side differences for the hip variables ($P > 0.05$). Shoulder external rotation (ER) was significantly greater than shoulder internal rotation (IR). And the lead leg hip had significantly greater ER than IR. Shoulder ER revealed significant correlations with both lead and stance hip IR ($r = 0.45$, $P = 0.02$ and $r = 0.48$, $P = 0.01$; respectively). **Discussion:** Youth baseball pitchers display similar ROM of patterns as collegiate and professional baseball pitchers. The present study reveals that the ROM patterns displayed by these youth may indicate that their ROM patterns survive maturation. It is therefore suggested that clinical focus be directed to maintaining hip and shoulder rotational ROM throughout maturation in attempt to determine a possible relation between injurious mechanisms as well as performance enhancement.

ITR 9 A pilot RCT to investigate the effects of a dynamic elastomeric fabric orthosis (DEFO) in athletes with pelvic/groin pain, across selected clinical and performance measures*Sawle L, Freeman J, Marsden J, Matthews M**Plymouth University, School of Health Professions, Plymouth, UK*

Introduction: Athletic pelvic pain is a common yet challenging problem. Pelvic belts have demonstrated some benefit in athletes by improving function and / or decreasing pain. More recently dynamic elastomeric fabric orthoses (DEFOs) have been developed based on an assessment of the clinical effects of different directions of compression around the pelvis. Preliminary findings from single case studies indicate that this DEFO may have a positive effect upon pelvic pain and performance measures. The aim of this study was to conduct a pilot randomised controlled trial in athletes with pelvic pain to: Inform the design and test the practicality of procedures for a future definitively powered RCT study; including details on recruitment and attrition rates. Provide an estimate of the effect size of the DEFO on selected clinical and performance measures. **Methods:** Twenty-four athletes with sub-acute and chronic pelvic conditions will be recruited from sports clubs across the UK. Random allocation using a minimization procedure will ensure equal distribution of participants between an intervention and control group. Participants in the intervention group will use the DEFO for 4 weeks whilst the control group will remain on the waiting-list for 4 weeks. Outcome measures will be taken by an assessor blinded to group allocation over 2 baseline sessions and after 2 and 4 weeks. Outcome measures include the active straight leg raise test, squeeze test, broad jump, and the multiple single-leg hop stabilization test. Subjective views about the DEFO will be obtained via exit questionnaires. **Results:** Testing commenced in January 2014 with recruitment occurring until the end of the December 2014. A CONSORT diagram will describe the flow of participants through the study and results will be summarised using descriptive statistics. **Discussion:** Criteria to proceed to a full RCT include 100% recruitment in 12 months and <20% attrition rate.

ITR 17 Epidemiology of injury in the hip/groin/thigh region in adolescent and collegiate Gaelic footballers and hurlers*O'Connor S, McCaffrey N, Whyte E, Moran K.**School of Health and Human Performance, Dublin City University, Dublin, Ireland*

Introduction: Injuries to the hip, groin and thigh are prevalent in adult Gaelic footballers and hurlers but the incidence of injury in adolescent and collegiate players has not been established. **Methods:** Adolescent ($n=292$, 15.7 ± 0.8 years) and collegiate ($n=342$, 19.4 ± 1.9 years) Gaelic footballers and hurlers took part in a one-year prospective epidemiological study. Injuries were assessed by an athletic rehabilitation therapist. **Results:** The hip/groin/thigh was the most common region of injury in adolescent (25%) and collegiate (35%) players, accounting for 1.4 and 5.4 injuries/1,000 hours in adolescents and collegiate players, respectively. The hamstring (9.6%, 16.1%), pelvis and groin (8.8%, 7.3%), quadriceps (6.4%, 7.3%), and hip (3.2%, 6.2%) accounted for a large proportion of injuries in adolescent and collegiate players, respectively. Strains (54.3%, 65.3%) and contusions (14.3%, 20.8%) were the most common. Non-contact injuries predominated (82.9%, 77.8%), with sprinting the most common mechanism of injury (65.7%, 47.2%). Injuries during tackling occurred more frequently in collegiate players (28.1%) than adolescents (5.7%). Injuries primarily occurred in the 4th

quarter in collegiate players (64.6%). Injuries occurred more frequently at the beginning of the calendar year, dropped significantly over the summer months and increased again nearing the end of the year. A similar percentage of minor (33.8%), moderate (35.2%) and severe (31.0%) injuries occurred in collegiate players, however severe (43.8%) injuries primarily occurred in adolescents, followed by minor (34.4%) and moderate (21.9%) injuries. **Conclusions:** Injuries to the hip/groin/thigh are common in adolescent and collegiate Gaelic footballers and hurlers. This study paves the way for injury prevention strategies in these populations.

ITR 18 Hamstring flexibility, squatting techniques and core stability in a musculoskeletal pre-participation screening assessment of adolescent and collegiate Gaelic footballers and hurlers

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Introduction: The purpose of this study was to establish normative screening data for hamstring flexibility, squatting techniques and core stability in adolescent and collegiate Gaelic footballers and hurlers. No normative screening data is available in this population which is a significant limiting factor to developing injury prevention strategies. **Methods:** Adolescent (n=426, 15.6±0.7 years) and collegiate (n=345, 19.4±1.9 years) Gaelic footballers and hurlers completed the active knee extension (AKE) (hamstring flexibility), adapted trunk stability (core stability), overhead squat and single leg squat tests. **Results:** Both adolescent (R=61.3 ± 13.4°, L=60.2 ± 13.2°) and collegiate (R=64.7 ± 11.6°, L=65.8 ± 11°) players displayed poor hamstring flexibility, with a higher percentage of participants at risk of injury with an AKE results of less 70° in adolescents (R=72.8%, L=77.2%) than collegiate players (R=63.9%, L=61.0%). Collegiate players displayed significantly better core stability results than adolescents ($P<0.0001$) with adolescents primarily receiving a "good" (41.9%) compared to the "excellent" (64.5%) rating in collegiate players. Collegiate players predominantly received an "average" (53.3%) rating during the overhead squat, compared to the similar "poor" (39.7%) and "average" (38.4%) ratings noted in adolescents. Collegiate players predominantly received a "poor" in the single leg squat (R=49.7%, L=48.3%) and only 3.9% received an "excellent" rating. In contrast, adolescents performed a better single leg squat; with a rating of "average" predominant (R=49.7%, L=52.8%). Both adolescent and collegiate participants performed poorly in similar components of the squatting technique including knees over toes and knee valgus; however greater trunk flexion and less depth were noted in collegiate participants. **Conclusions:** Injury prevention programmes targeting hamstring flexibility and squatting techniques are needed in adolescent and collegiate Gaelic footballers and hurlers.

ITR 23 Inter and intra-tester reliability of the electronic inclinometer application in measurement of hip range of motion and muscle length in elite Gaelic footballers: A preliminary report

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Introduction: The measurement of hip joint range of motion and lower limb muscle length is necessary in all field sports for baseline testing, injury diagnosis and performance analysis. It can be time consuming and inaccurate if not carried out correctly and often requires two people. The aim of this study was to determine the intra-rater and inter-rater reliability of an electronic inclinometer in determining hip joint ROM and muscle length in elite Gaelic footballers. **Methods:** 17 elite, male Gaelic footballers (19.92, ± 1.7 years) were recruited for this study. Three certified Athletic and Rehabilitation therapists carried out all ROM and muscle length measurements bilaterally. These measurements consisted of hip internal and external rotation, active knee extension and Thomas tests. This protocol was repeated in a re-test session carried out 3 hours later. Intra-class correlation coefficients (ICC) were used to assess reliability. Weak reliability was identified by an ICC value <0.40, moderate reliability 0.40-0.75 and strong reliability >0.75. **Results:** Strong inter-tester reliability was found for the active knee extension test (ICC = .992), Thomas test (ICC = .982), internal rotation (ICC = .952) and external rotation (ICC = 0.963) ($P<0.001$). The intra-tester reliability was also strong with ICC values for the 3 testers ranging from .956-.975 for the active knee extension, .818-.887 for the Thomas test, 0.825-0.842 for internal rotation and 0.900-0.939 for external rotation ($P<0.001$). **Conclusions:** Inter-tester and Intra-tester reliability was significantly strong for all tests. Therefore, the use of an electronic inclinometer application is recommended for the measurement of hip range of motion and lower limb muscle length in elite Gaelic footballers.

ITR 31 The relationship between adductor-abductor strength imbalance and performance of a functional hop in elite gaelic football players*Callinan S, O'Connor M & O'Doinn T**School of Health and Human Performance, Dublin City University, Dublin, Ireland*

Introduction: It has been previously identified that strength imbalances of the hip adductor and abductor musculature is an intrinsic risk factor for groin strain in athletes which may lead to long term pathologies. The synergistic action of the hip adductor and abductor musculature stabilizes the pelvis on the stance leg whilst performing single leg activities, and hence is important during athletic manoeuvres such as cutting and high velocity changes of direction. Despite the prevalence of hip and groin injuries in Gaelic football there has been very little research on the topic to date. The purpose of this preliminary study was to determine if a functional hop test has the capacity to indicate the presence or absence of hip joint adductor-abductor strength imbalances. **Methods:** Thirteen elite Gaelic footballers (mean age = 19.2 years, standard deviation = 1.2 years) were included in a single test trial. Both legs were tested using hand-held dynamometry and the triple hop for distance. Maximum voluntary isometric contraction of the hip joint adductors and abductors were used to subsequently calculate a hip adductor-abductor ratio. The relationship between this ratio and the triple hop for distance score was evaluated using the Pearson product moment correlation. **Results:** An insignificant moderate positive correlation ($r = 0.213$, $p = 0.297$) was observed between adduction-abduction strength ratio and triple hop for distance. **Discussion:** From our study it can be seen that the triple hop for distance is not a good indicator for hip adductor-abductor strength imbalances. Further research should focus on other functional tests which could possibly identify those who are susceptible to adductor injuries.

ITR 35 To identify intrinsic risk factors for groin/hip injuries among academy level rugby union players: a prospective cohort study*Ryan J, DeBurca N, Coole A, McCreesh K**Irish High Performance Boxing Unit, Dublin, Ireland*

Introduction: Groin/Hip injuries are among the top 6 most commonly cited injuries in Rugby Union (RU). These injuries have increased significantly since 2002 moving from 16th to 4th place in the most common training injuries in 2012 RU annual audit. Objective: to identify intrinsic risk factors for groin/hip injuries in an academy level RU population. **Methods:** This study is a prospective cohort design. 43 players were recruited and tested pre, mid and end season by primary investigator. Inclusion criteria: Academy level RU players from provincial teams, over 18 years of age, fluent in English with written consent. Exclusion criteria: Injured or non-consenting players. Risk factor assessment: Hip adductor squeeze strength, hip abductor/adductor isometric strength, passive and active internal/ external hip rotation ROM, hip abduction ROM, adductor flexibility, groin palpation and quality of single leg squat were examined. Anthropometric data was collected using questionnaires. Team physiotherapists recorded injuries using OSCIS grading system. **Results:** Incidence of groin/hip injuries was 21%. Non-modifiable risk factors identified were previous injury ($P=0.001$, Odds Ratio (OR)=13.5) and smaller player height ($P=0.011$, OR=6). Modifiable risk factors identified included: lower isometric squeeze strength ($P=0.049$, OR=4), reduced dominant leg ($P=0.029$, OR=13) and bilateral mean adductor flexibility ($P=0.045$, OR=7.5), greater dominant ($P=0.046$, OR=9) and non-dominant ($P=0.021$, OR=6) hip internal rotation ROM and positive tenderness of adductor origin musculature ($P=0.049$). **Conclusions:** This study succeeded its objective. This is of significant importance clinically due to high injury incidence leading to missed training/matches and associated costs. Future research should call on the rugby community to implement these identified risk factors in the development of a screening tool for groin/hip injuries and examine its efficiency at reducing the incidence of injury thus taking the next step in groin/hip injury prevention.

ITR 38 Effects of a 12-week intervention of the GAA 15 on jump-landing mechanics and balance of Minor level Gaelic football players*Maguire D, Fox D, & Blake C**School of Public Health, Physiotherapy and Population Science, UCD, Dublin, Ireland*

Introduction: The GAA 15 is a novel injury prevention programme developed with the aim of improving the neuromuscular control of players, and ultimately a reduction of incidence of injury. The GAA 15 has previously been shown to enhance player dynamic stability and landing symmetry in a collegiate population. The aims of this pilot study were to assess the feasibility and efficacy of the GAA 15 as a warm-up in a Minor-level Gaelic football population, through measurement of jump-landing mechanics and dynamic single leg balance.

Methods: A quasi-experimental, single group, pre-test post-test design was used to assess change in landing

mechanics, using the Landing Error Scoring System (LESS) and dynamic balance, using the Y Balance Test, of 11 male Minor level Gaelic Football players, following a 12 week intervention of the GAA 15. The GAA 15 was administered as a warm-up at the start of 20 pitch-based training sessions. Y Balance change was assessed with a paired t test, while the Wilcoxon Sign Rank test assessed LESS change. Effect size statistics were calculated. **Results:** Group mean LESS decreased from 4.91 ± 3.02 to 4.18 ± 2.32 ($P=0.07$, $ES=0.27$). Group mean Right Y Balance Composite Score increased from $80.24\% \pm 7.92$ to $87.33\% \pm 7.85$ ($P=0.001$ Effect Size=1.31). Group mean Left Y Balance Composite Score increased from $82.16\% \pm 7.39$ to 88.07 ± 7.89 ($P=0.009$ $ES=0.97$). No adverse effects were reported. **Conclusion:** A 12-week intervention of the GAA 15 significantly improved Y Balance Composite Scores of male Minor level Gaelic Footballers. LESS scores decreased as a result of the intervention but this did not reach statistical significance in this small sample. The GAA 15 is safe and effective as a warm-up, in a male Minor Gaelic football population, as an intervention which improves outcome measures which are associated with injury risk.

ITR 64 Screening for hamstring and groin injury risk in GAA: current GAA-funded project and provisional data

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Introduction: Groin injuries account for over 10% of injuries in Gaelic Games with 30% of those being recurrent injuries. Approximately 20% of Gaelic Games injuries are to the hamstring muscles with 33% of these being recurrent in nature. The cumulative time lost due to these injuries is of concern. Injury screening is becoming a common practice as clinicians attempt to identify those who may be at risk of suffering injury and intervening so as to reduce risk. Weakness and asymmetry between left and right sides have previously been suggested as potential injury-causing factors. **Methods:** Seventy four Gaelic Games players were screened using the single leg hamstring bridge test and hip flexion, abduction and adduction dynamometry; two measures which have previously shown to have predictive value for the occurrence of groin and hamstring injury. Asymmetries between sides were noted for all tests and a ratio between adductor and abductor hip strength was computed for each limb. These players are currently being followed prospectively for the occurrence of hamstring and groin injury using the GAA National Injury Surveillance Database. **Results:** For the SLHB 20.4% of limbs scored below the cut-off of 20 repetitions and were classified as at risk of hamstring strain with 31% of players displaying an asymmetry of > 5 repetitions. Twelve percent of limbs displayed a hip adduction: abduction strength ratio of less than the cut-off of 70% with 59.2% of players displaying asymmetries between sides in their adduction: abduction strength ratio. **Conclusions:** According to criteria previously stated in the injury prediction literature, a large amount of these players are at risk of developing hamstring injuries and groin injury. However these tests have not been described for this population as of yet and the predictive may not hold true in Gaelic Games athletes. I would like to bring to your attention that the abstract above regards an ongoing project and I have submitted it with provisional data. By the time the conference rolls around I will have the paper fully completed with full data, including a prospective follow up on the players already measured. Please take this into account as the abstract will be much more robust when all data is at hand.

ITR 65 The motor control strategies underpinning landing failure: is there a potential link between CAI and knee injury risk?

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Introduction: Failed trials of dynamic tasks are typically discarded in biomechanical analyses with the loss of potentially informative data. Study aim: To compare failed and successful drop land (DL) trials completed by participants with chronic ankle instability (CAI) and the successful trials of a 'coper' group. **Methods:** Nineteen participants with self-reported CAI failed three attempts at a DL task, before successfully completing three trials, while nineteen copers successfully completed three trials, all on their designated 'affected' limb. 3-dimensional kinematic and kinetic data were acquired for the lower extremity joints from 200ms pre-initial contact (IC) to 200ms post IC during the DL task. **Results:** The failed trials of CAI participants were characterised by increased pre- and post-IC hip flexion, post-IC ankle eversion and foot abduction, with increased post-IC knee abduction moment and reduced ankle inversion moment in comparison to the copers' successful trials ($P<0.05$). The only difference between CAI participants' failed and successful trials was increased post-IC knee abduction moment ($P<0.05$). Direct logistic regression elucidated that post-IC maximum knee abduction moment was statistically significant ($P=0.005$) in predicting a fail in CAI participants. **Discussion:** The current analysis provides novel insight into the causative mechanisms underpinning landing

task failures in participants with CAI. The only feature unique to CAI participants' failed trials in comparison to their own successful trials was an increase in post-landing knee abduction moment. This may advocate a potential link between CAI and future knee injury in light of the previously established risk associated with this motor pattern.

ITR 66 Lower extremity coordination and symmetry patterns during a drop vertical jump task following acute ankle sprain.

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Introduction: The drop vertical jump (DVJ) is frequently utilised in biomechanical analyses as it effectively recreates the limb-synchronous rebounding mechanics and associated injury mechanisms typical of many sports. An acute lateral ankle sprain (LAS) injury may distort the inter-limb symmetry necessary for the absorption of forces associated with explosive DVJ-based skills, potentially placing the contralateral limb at increased risk of trauma. Study aims: Evaluate the potentially adaptive movement patterns associated with acute LAS using biomechanical analyses during the DVJ. **Methods:** Thirty participants with acute LAS and nineteen controls performed a DVJ task. 3D kinematic and sagittal plane kinetic profiles were plotted for the hip, knee and ankle joints of both limbs for the drop jump (phase 1) and drop landing (phase 2) phases of the DVJ. Inter-limb symmetry and the rate of force development (RFD) relative to bodyweight (BW) during both phases of the DVJ were also determined. **Results:** The LAS group displayed reduced ankle plantar-flexion on their injured limb during phase 2 of the DVJ, with greater associated inter-limb asymmetry for this movement ($P<0.05$). The LAS group also displayed altered kinetic profiles, with increased inter-limb hip asymmetry for both phases of the DVJ ($P<0.05$). This was associated with a decrease in the LAS participants' injured limb RFD during phase 2 of the DVJ when compared with that of controls ($11.76 \pm 3.43\text{BW}/\text{sec}$ vs $14.60 \pm 3.20\text{BW}/\text{sec}$; $p = 0.01$, $\eta^2 = 0.14$). **Discussion:** Participants with LAS display potentially aberrant coordination strategies during a DVJ task, as evidenced by an increased dependence on the non-injured limb. Clinicians must be aware that acute LAS injury has the capacity to cause bilateral impairment, and potentially increase the risk of injury to the non-injured limb secondary to the asymmetry created by its compensatory role in protecting the injured joint.

ITR 67 Clinical assessment of countermovement jump landing kinematics in early adolescence: sex differences and normative values.

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Introduction: Adolescent females have been reported to have a higher risk of non-contact knee joint injury compared to their male counterparts, with deficiencies in neuromuscular control being purported to be the primary differentiating factor. As such assessment of movement quality during functional screening tests in this population is warranted. Widespread implementation of such screening requires clinically accessible screening measures and normative data. Therefore, the aim of the present study was to provide normative data for clinical analysis of landing biomechanics in early adolescent male and female athletes, with a corollary of determining whether a difference between the sexes is evident with such screening. **Methods:** Eighty seven male and 75 female athletes (mean age = 13 ± 1 yr) in their first year of high school participated. Each participant performed 3 countermovement jump trials. Frontal and sagittal plane knee joint angles were recorded by video cameras for both dominant and non-dominant limbs. **Results:** Males displayed significantly greater knee flexion pre-IC (dominant: mean difference = 11.05° , $P<0.001$; non-dominant: mean difference = 4.42° , $P<0.001$) and greater knee varus motion (dominant: mean difference = 3.67° , $P<0.001$; non-dominant: mean difference = 4.61° , $P<0.001$). No differences were observed between males and females in limb asymmetries. **Discussion:** Early adolescent female athletes demonstrate less desirable jump landing biomechanics than their male peers. First year in high school, when early adolescent females are first exposed to high school sports, may be an ideal time to assess movement quality during functional tasks and intervene with appropriate injury prevention programmes if necessary.

ITR 74 Does isokinetic quadriceps strength predict outcome during single leg vertical jump height after ACL reconstruction?*Ward J, Marshall B, Franklyn-Miller A & Falvey E**Department of Sports Medicine, Sports Surgery Clinic, Dublin, Ireland*

Introduction: A battery of tests is commonly used to determine readiness to return to competition and prevent re-injury after anterior cruciate ligament (ACL) reconstruction. Isokinetic assessment of the quadriceps muscles and single leg vertical jump height are two clinical tests used to establish the strength, power and functional stability of the operated limb. Little is known about the relationship between these two tests and success in one predicting outcome in the other. This study aims to determine the correlation between single leg vertical jump height and peak knee extensor torque. **Methods:** Thirty male athletes post ACL reconstruction (mean 27.67 ± 0.9 weeks) were recruited. Concentric knee extensor torque was collected using a Cybex Norm isokinetic dynamometer at an angular velocity of 60° per second. Single leg vertical jump height was calculated using eight Vicon Cameras and two AMTI force plates. Limb symmetry index (LSI) was used to express the results of the tests. **Results:** There was no significant correlation between LSI in the single leg vertical jump and LSI in the quadriceps ($r = -0.02, P = 0.34$) isokinetic strength test. **Conclusion:** Open kinetic chain knee extensor strength demonstrated low correlation with vertical jump performance. Single leg vertical jump assesses muscle function across multiple joints whereas open chain assessment of quadriceps strength is less functional but more likely to detect specific muscle dysfunction. Both tests are valuable in determining readiness to return to competition but should not be used interchangeably as they assess different components of rehabilitation.

ITR 86 A manual therapeutic muscle manipulation and early return to sports in footballers with long-standing adductor-related groin pain; a prospective case series*Tak I, Bertrand B, Langhout R & Weir A**Fysiotherapie Utrecht Oost, Sports Rehab & Manual Therapy Department, Utrecht, The Netherlands*

Introduction: A manual manipulation of the adductors results in reduction of complaints in athletes with long-standing adductor-related groin pain (LARGP). The objective was to assess effects of this treatment when combined with early progressive return to sport (RTS). **Methods:** This was a prospective case series. Treatment was a manual therapeutic manipulative stretch of the adductors in transverse and longitudinal proximal direction. RTS allowance was immediately after treatment. Follow-up was at 2, 6 and 12 weeks assessing pain levels with numeric pain rating scale (NPRS), daily report of sports activity, Hip and Groin Outcome Score (HAGOS) and global perceived effect (GPE) for treatment and patient satisfaction. **Results:** Thirty-four footballers with LARGP who were restricted in sports were included. Within two weeks 82% returned to pre-injury playing level at an average of 5.3 (1-14) days. At twelve weeks this was 88%. Pain reduction was significant ($P < 0.001$) from NPRS 7 (6-8) to 1 (0.2-3) during sports. Significant ($P < 0.001$) improvement was observed on all HAGOS subscales. Clinical relevant improvement was reported by 85% and 82% was satisfied. **Conclusion:** For the majority of footballers with LARGP manual treatment and early RTS leads to significant improvement and RTS within 2 weeks. The improvement is maintained at 12 weeks. Early RTS did not seem to have negative effects when compared to studies on this treatment with longer return to sport times. More robust study designs are needed to establish this.

ITR 87 A new clinical test for instep kick mobility in footballers: design, reliability testing and findings in healthy players and players with long-standing adductor-related groin pain*Tak I, Langhout R, Groeters S & Weir A**Fysiotherapie Utrecht Oost, Sports Rehab & Manual Therapy Department, Utrecht, The Netherlands*

Introduction: Reduced hip range of motion has been associated with groin pain in athletes. This association is poorly understood and literature does not provide us with accurate measurement methods to help analyse this problem. Aim of this study was to develop a test that measures sport specific range of motion (SSROM) of the lower limb for the football instep kick. Its reliability and findings in non-injured and injured players were studied. **Methods:** Sport specific extension, adduction, abduction, internal and external rotation of both legs were examined with inclinometers in 103 elite, 82 amateur and 57 footballers with unilateral adductor-related groin pain. Test-retest reliability (ICC), standard error of measurement (SEM) and minimal detectable change (MDC) were calculated. Non-injured players were compared with the injured group. **Results:** Intra and inter tester ICCs ranged from 0.90-0.98 and 0.50-0.88. SEM ranged from $1.3-9.2^\circ$ and MDC from $3.7-25.6^\circ$ for separate directions and total SSROM. Non-injured elites showed $190(SD \pm 25)^\circ$ and $188(SD \pm 25)^\circ$ of total ROM for the non-dominant and dominant leg. Amateurs displayed $188(SD \pm 25)^\circ$ on both sides. Injured players showed

significant ($P<0.05$) SSROM deficit with $187(SD\pm 31)^\circ$ on the healthy and $135(SD\pm 29)^\circ$ on the injured side. Receiver operator characteristic calculation showed that 17% ROM deficit was the optimal (sensitivity 0.91, specificity 0.94) cut-off point to distinguish between healthy and injured subjects. **Conclusion:** The test has acceptable reliability and demonstrates no differences between amateurs and professionals or between legs. Injured players with unilateral adductor-related groin pain show significant loss of SSROM on the injured side.

ITR 113 Effects of yoga and Pilates on dynamic postural control in college-aged males and females

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Introduction: Assessment of dynamic postural control (DPC) has been shown to be an effective tool in measuring lower extremity deficits. The Star Excursion Balance Test (SEBT) and the Y-Balance Test Kit (YBTK) have both been shown to be reliable measures for testing DPC. The aim of this study was to examine the effects of Yoga and Pilates Training Program on the DPC measures of college-aged males and females. A second objective was to investigate the similarity between the DPC measurements achieved on SEBT and the YBTK. **Methods:** Twenty five college-aged males and females (25 ± 6 yr) enrolled in an introductory Yoga and Pilates class, voluntarily participated in fourteen sessions of class over a five week period. DPC measurements were assessed using the SEBT and YBTK 1 week pre and 1 week post training. **Results:** Significant difference was found between these two tests of DPC ($F=6.291$; $P=0.02$). A four way ANOVA was calculated to assess the differences among anterior, posteromedial, and posterolateral reach directions. Significance was found between reach directions ($F=126.51$; $P=0.000$). To test the mean difference of the SEBT and Y-Balance Test™ by direction, a four-way ANOVA was calculated. Significance was found ($F=270.012$; $P=0.000$) suggesting that the differences were dependent on the relationship of both tests of postural control and each of the three directions. No difference was found in DPC measures after fourteen sessions of a Yoga and Pilates class. **Conclusion:** These findings suggest that fourteen sessions of combined Yoga and Pilates training over a 5-week period did not improve DPC. A significant difference was found in the SEBT and YBTK among all reach directions therefore when testing DPC these tests must not be used interchangeably. The results of this study showing that anterior, posteromedial, and posterolateral reach directions are not similar is consistent with the literature.

ITR 123 An investigation into the contributing factors to 438 athletes presenting with hamstring injuries to a sports injury facility over a five year period

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Introduction: Hamstring injuries commonly occur in field sports with high speed running. It is reported that 10% of elite soccer players experience a hamstring injury each season. Purpose: The purpose of this study was to report and identify the location, severity and mechanisms of and contributing factors to hamstring injuries that athletes presented with at a sports injuries facility. **Methods:** Retrospective data was collected on athletes presenting with hamstring injuries to a sports injury facility from 2009 to 2014. Sport, mechanism of injury, degree of injury, chronicity, size and location of injury were recorded. **Results:** 438 players attended with hamstring injuries. This consisted of 206 (47%) Gaelic footballers, 124 (28%) soccer players, 66 (15%) hurlers, 26 (6%) rugby players and 16 (4%) other sports participants. 254 (58%) players experienced a grade I strain, with 51 (11%) having a chronic strain of greater than 6 months duration. 256 (58%) of the injuries occurred in Biceps Femoris. 160 (37%) were resulting from deceleration with 78 (18%) resulting from fatigue, 74 (17%) during acceleration, 66(15%) due to inadequate warm-up, 35 (8%) due to over stretching/reaching and 25 (5%) others. **Discussion:** The results of this study support previous research that reported a high incidence of hamstring injuries in Gaelic football, the biceps femoris to be the most commonly injured of the hamstrings and that injuries tend to occur during the deceleration and acceleration. Fatigue and inadequate warm-up were also reported to be risk factors contributing to 33% of all hamstring injuries. The results of this study suggest that fatigue is a particular risk factor for hamstring injuries in Gaelic footballers with 85% of fatigue related injuries occurring in this population. **Conclusion:** Inadequate warm up and fatigue are contributing factors to hamstring injuries, particularly in Gaelic footballers.

ITR148 Examining the test re-test reliability of the multiple single-leg hop-stabilisation test and the relationship with leg dominance, age and training.

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Introduction: Within sports medicine assessing an athlete's balance is an important part of a clinical examination. However there is no gold standard measure for assessing balance in athletes. The multiple single leg hop stabilisation test (MSLHST) is a functional test comprising of static and dynamic components; it may offer an appropriate way of assessing athletic balance and postural control. If it is to be used in clinical practice and research trials for longitudinal monitoring it needs to show adequate test retest reliability. **Aim:** To examine the test retest reliability of the MSLHST and investigate possible performance indicators such as limb dominance and age. **Methods:** Fifteen healthy, active participants were recruited from University staff, students and local athletes. Participants were tested on two occasions with a 10 minute break in between. All testing was undertaken in a University Human Movement Laboratory, and the outcome measure was the MSLHST score on the dominant and non-dominant leg. Results were analysed using an Intraclass Correlations Coefficient (ICC) and Bland Altman plots. Regression analysis explored the relationship between MSLHST scores and the effects of age and training. **Results:** The ICCs were 0.85 for the dominant and non-dominant legs. Confidence intervals ranged from 0.62-0.95 and 0.61-0.95 respectively. Bland Altman plots showed all scores were within 2 standard deviations. Linear regression analysis showed that balance scores on the dominant and non-dominant leg were correlated, and that better balance was associated with decreasing age and greater number of hours spent in sporting activity per week. **Conclusion:** The MSLHST demonstrated good to excellent test retest reliability within a healthy, active population. People who are younger and spend more time in training per week have better balance scores. This functional measure may be considered as a useful outcome measure for evaluating athletic balance in future studies.

SCI 12 Gluteus medius relation to scapula stabilization in baseball pitching*Henning L, Oliver G, & Weimar W**School of Kinesiology, Auburn University, Auburn USA*

Introduction: The scapula must coordinate the demands of humeral positioning and energy transfer while providing a stable platform for muscle attachments. In order for the scapula to fulfil these roles it must rely on the pelvis for stability. It was the purpose of this study to determine the relationship between the activation of gluteus medius [GM] and the primary force couple of the scapula (lower trapezius [LT], upper trapezius [UT], and serratus anterior [SA]) during baseball pitching. **Methods:** Twenty youth baseball players [11.3±1.0 years; 152.4±9.0 cm; 47.5±11.3 kg] participated. Surface electromyography [sEMG] synced with motion analysis was used to determine muscle activations of lower trapezius, upper trapezius and serratus anterior throwing arm side of the body as well as bilateral gluteus medius. Data were recorded while participants threw maximal effort four-seam fastballs for strikes a regulation distance [14.02 m] to a catcher. The fastest pitch was selected for analysis. The pitching phase from foot contact to maximum shoulder external rotation was analysed. **Results:** Pearson's correlation revealed significant relations between bilateral GM and the force couples about the scapula. Contralateral GM had moderate to high correlations with LT [$r=0.70$; $P<0.01$], UT [$r=0.71$; $P<0.01$], and SA [$r=0.56$; $P<0.05$]. Ipsilateral GM had high correlations with both the UT [$r=0.78$; $P<0.01$], and SA [$r=0.78$; $P<0.01$]. **Discussion:** Adequate energy transfer from the lower to upper extremity relies on proper function of the pelvis and torso to provide a stable base of support for the scapula. This allows for appropriate activation of the force couple of the scapula, thus having a strong impact on throwing efficiency. Results of this study provide important data that improve the understanding of the relationship between the pelvic stabilizers and the scapular stabilizers during the fastball pitch.

SCI 13 Hip passive range of motion in youth baseball pitchers*Holt T & Oliver G**School of Kinesiology, Auburn University, Auburn, USA*

Introduction: Range of motion (ROM) variables have long been suspected as contributing to injury in baseball pitchers, however previous research has focused on the ROM of collegiate and professional pitchers particularly only of the upper extremity. It was the objective of this study to examine passive hip rotational (PROM) in youth baseball pitchers. **Methods:** A total of twenty-one youth baseball pitchers (11.2 ± 0.8 years; 151.4 ± 9.0 cm; 46.0 ± 10.3 kg) with no history of injury, participated. Hip rotation PROM [internal and external] was measured with the subject in a seated position, knees flexed to 90° allowing the legs to comfortably hang off the edge of the table [standard athletic training treatment table]. A towel was placed under the femur being tested to allow for 90° of hip flexion, and a digital inclinometer was aligned along the shaft of the subject's tibia. Examiner supported the femur and passively rotated the lower shank [internally and externally] until a resistive end feel was achieved in the hip. **Results:** Stride PROM external rotation [ER] was 37.5° + 7.5°; internal rotation [IR] 28.5° + 5.5°; and total arch 66.0° + 8.5°. Stance PROM ER was 35.3° + 6.4°; IR 33.9° + 8.7°; and total arch 69.2° + 10.9°. **Discussion:** Adequate hip ROM is paramount during pitching because it allows for optimal energy transference from the lower to upper extremities. Deficits in stance hip IR can result in diminished trunk coiling during wind-up and decrease pitcher's ability to generate kinetic energy. Stride hip ER is a critical component in determining foot orientation at foot contact. Limitations in total hip ROM, as exhibited by the pitchers in this current study, could place increased demand on the upper extremity to make up for the energy loss in the hips and trunk

SCI 16 Performance related factors in countermovement jumps (CMJs)*Richter C, Marshall B, O'Connor N, & Moran K**Insight Centre for Data Analytics, Dublin City University, Dublin, Ireland*

Introduction: Findings of biomechanical injury and performance studies are often inconsistent, significantly limits their application. Possible reasons for this are the commonly used single-group-analysis design and discrete point analysis (DPA). The aim of this study was to identify performance related factors (PRFs) for CMJs using a subgroup analysis in combination with a continuous data analysis. The CMJ was chosen over injury data because performance outcomes can be clearly measured and related to kinetic measures. **Methods:** Kinematic and kinetic variables of the ankle, knee and hip joint of 116 athletes who performed a CMJ were analysed. Hierarchical clustering was used to cluster the data into three subgroups. Analysis of Characterizing Phases (ACP) in combination with a correlation analysis was used to identify PRFs. A regression analysis was used to assess the ability to describe jump height (regression-model r^2), using its r^2 -value. **Results:** PRFs were: Single-group: Regression-model $r^2=0.85$ Cluster1: Regression-model $r^2=0.96$; Ankle angular velocity 57-100%,

moment 24-82%, power 27-96%; knee angular velocity 78-100%, moment 95-100%, power 95-100% and hip angle 1-100%, angular velocity 30-100%, moment 1-100%, power 12-100%. Cluster2: Regression-model $r^2=0.90$; Ankle angle 63-100%, moment 13-100%, power 89-100%; knee angle 88-100%, angular velocity 95-100%, moment 98-100%, power 98-100% and hip angular velocity 97-100%, moment 98-100%, power 98-100%. Cluster3: Regression-model $r^2=0.80$; Ankle angular velocity 83-100%, moment 1-99%, power 66-100%; knee angle 88-100%, angular velocity 71-100%, moment 1-85%, power 12-86 & 98-100% and hip angle 39-100, angular velocity 79-100%, moment 10-88%, power 27-88%. **Conclusion:** Analysis of biomechanical data was enhanced using ACP and a subgroup analysis design in comparison to the traditional single-group DPA, as evident by the differences in PRFs between groups and the higher regression values. This explains, at least in part, the contrasting findings between previous studies; thereby suggesting its application in injury based biomechanics.

SCI 41 Biomechanical symmetry in elite injury-free rugby union players during dynamic movements: an examination of three dimensional kinematic and kinetic variables.

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Introduction: Biomechanical asymmetry during sporting movements may provide an insight into future injury risk. However, normative ranges of asymmetry for elite athletes during sport specific movements are currently lacking. In addition, the traditional method of examining asymmetry using a discrete point analysis requires examination with complete wave form techniques such as analysis of characterising phases (ACP). **Study Aims:** To examine asymmetry in a single leg drop landing (drop), a single leg hurdle hop (hop) and a running cut (cut) using both a discrete point analysis and ACP. **Methods:** 16 international injury free rugby players were recruited. A biomechanical assessment of a drop, a hop and a cut was undertaken on both dominant and non-dominant sides. Repeated measure t-tests ($\alpha=0.05$) were used to examine differences between limbs. **Results:** In the discrete point analysis the majority of biomechanical variables displayed no significant asymmetries ($P>0.05$) in the drop (20/21), hop (23/24) or cut (23/24). A similar trend was observed in the ACP results but this method did identify one more asymmetrical variable in both the drop and the cut. **Discussion:** Elite injury free rugby union players tend to exhibit bi-lateral symmetry across a broad range of biomechanical variables in a drop, hop and cut. This study provides useful normative values for inter-limb symmetry in these movement tests. It is recommended to utilise ACP methods in future examinations of symmetry as a discrete point analysis alone may increase the risk of type-two errors. A small number of asymmetries were identified: pelvis frontal plane angles in the drop and hurdle hop, and ankle sagittal plane angles and internal rotation moment in the cut. Prospective studies are required to establish the relevance of these biomechanical asymmetries.

SCI 44 The effects of 21 days of bed rest on mitochondrial oxidative capacity

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Introduction: Physical inactivity is the 10th leading contributor to the burden of chronic disease. Reduced skeletal muscle mitochondrial capacity and a reduction in intrinsic mitochondrial function in response to physical inactivity or bed rest may have broad implications for human disease. The aim of this study was to test the hypothesis that oxidative phosphorylation and electron transport capacity are diminished in response to 21 days head down tilt bed rest. **Methods:** The O_2 flux capacity of permeabilised skeletal muscle fibres obtained by muscle biopsy from the vastus lateralis was measured using high resolution respirometry before and after 21 days of bed rest. Subjects were assigned to the resistive vibration exercise (RVE) group ($n=11$), nutrition and exercise (NEX) group ($n=8$) and the control group ($n=11$). We measured the capacity of the electron transport system with high-resolution respirometry by applying two substrate-uncoupler-inhibitor-titration (SUIT) protocols. Citrate synthase enzyme activity was also measured and was used to normalize for mitochondrial content. **Results:** O_2 flux expressed per mg of wet weight of muscle tissue was lower during LEAK respiration following 21 days of BR ($P=0.024$). LEAK respiration was measured in the presence of pyruvate and malate and in the absence of ADP. OXPHOS and ETS capacity showed a moderate decline following BR. Citrate synthase activity was significantly reduced ($P=0.01$). **Discussion:** A reduction in LEAK respiration is an indicator of reduced mitochondrial uncoupling which, independently of mitochondrial content, has been associated with an increase in reactive oxygen species (ROS) production and dysregulation of lipid metabolism in skeletal muscle. Such changes may lead to altered cellular metabolism, ectopic fat storage and insulin resistance. Physical inactivity-mediated reductions in oxidative metabolism may inhibit skeletal muscle function and metabolism.

SCI 54 Landing biomechanics of the uninjured contralateral knee in a bilateral countermovement jump 6 months post anterior cruciate ligament reconstruction*Farrell E, Marshall B, Falvey E, & Moran K**Sports Medicine Department, Sports Surgery Clinic, Santry Demesne, Dublin, Ireland*

Introduction: Field sports have high rates of anterior cruciate ligament (ACL) injuries where athletes are required to engage in various landing activities. Following ACL reconstruction (ACLR), research shows that the contralateral leg may develop compensatory landing mechanisms, exposing the contralateral ACL to greater risk of injury. **Aims:** To investigate the presence of compensatory landing mechanisms on the contralateral leg post ACLR during a countermovement jump. **Methods:** 30 male recreational field sport athletes, on average 6 months post ACLR, (age: 21.2 ± 3.4 yr; height: 180.4 ± 6.8 cm; weight= 81.1 ± 8.6 kg) took part in this study. 3D biomechanical data was collected for the first 100ms of the landing phase of a countermovement jump using 8 VICON cameras (200Hz) and 2 AMTI force plates (BP400600). The kinetics and kinematics of the ankle, knee and hip and peak vertical ground reactions forces (vGRF) were analysed. A paired samples t-test examined significant differences ($P < 0.05$). **Results:** The uninjured limb contacted the ground first in 60% of observed landings. The uninjured side had significantly higher peak vGRF, ankle flexion, knee flexion, knee valgus, knee internal rotation, knee valgus moment and external hip rotation ($P < 0.05$). Non-significant findings included peak hip flexion angles ($P = 0.55$) and hip adduction ($P = 0.17$). **Discussion:** It would appear that in an effort to reduce the risk of re-injury to the injured knee, ACLR patients may increase the risk of a contralateral ACL injury. This was evident in the tendency to land on the contralateral limb first and do so with greater peak vGRF, knee valgus angle, knee valgus moment and knee internal rotation. These factors have all been associated with ACL injury in previous studies. Interestingly, contralateral landings also involved greater ankle and knee flexion and external hip rotation which may indicate a potential compensatory movement to reduce this injury prone position.

SCI 58 Landing kinematics and kinetics of double and single leg countermovement jumps following anterior cruciate ligament reconstruction*Undheim M, Marshall B, Falvey E & Franklyn-Miller A**Sports Medicine Department, Sports Surgery Clinic, Santry Demesne, Dublin, Ireland*

Introduction: Landing from a jump has been reported as one of the primary movements where non-contact anterior cruciate ligament (ACL) injuries occur. Though single leg (SL) landings have been reported as the more common landing mechanism for injury, both double leg (DL) and SL landings are used to assess a patient's progress during rehabilitation following ACL reconstruction (ACLR). **Aim:** To evaluate the lower limb biomechanics of a DL and SL countermovement jump (CMJ) in the first 100ms of the landing phase. **Methods:** 30 recreational male field sports athletes, on average 6 months post ACLR, (age: 21.2 ± 3.4 years; height: 180.4 ± 6.8 cm; weight: 81.1 ± 8.6 kg) were evaluated performing DL and SL CMJs. 3D biomechanical data was captured using 8 VICON cameras and 2 AMTI force plates. A paired samples t-test examined significant differences between injured and uninjured leg for DL and SL landings. A Pearson's correlation coefficient was used to investigate the relationship between the variables in the DL and SL CMJ landing. An alpha level of $P < 0.05$ was adopted for significance. **Results:** The DL and SL CMJ landing showed similar trends in landing mechanics, where the uninjured leg landed with significantly greater hip flexion, hip external rotation, knee flexion, knee internal rotation, eccentric knee valgus moment, and ankle flexion ($P < 0.05$). However, the peak vGRF and peak knee internal rotation were the only significant correlations found for both involved and uninjured sides ($P < 0.05$). **Conclusion:** For the DL landing, the participants landed predominantly with their uninjured leg first, compensating by landing with greater ankle, knee and hip flexion. Similar landing mechanisms were found for SL landing. However, with the exception of 2 variables, there were no significant correlations found between DL and SL landing biomechanics. This indicates the importance of assessing both DL and SL landing biomechanics following ACLR.

SCI 88 Effect of changing muscle length on electromyographic activity and maximal force production of the knee flexor musculature*Lyons J, Donne B & Mahony N**Human Performance Laboratory, Anatomy Dept., Watt's Building, Trinity College Dublin, Ireland*

Introduction: Hamstring muscle injuries occur frequently in field based sports. Despite studies evaluating hamstring injuries and rehabilitation, rates of injury and re-injury have not improved significantly over the last three decades. We investigated the effect of varying hamstring length on EMG activity and force production during maximal knee flexor isometric actions. **Methods:** Currently, six healthy male participants (mean: age

24yr, height 1.86m, mass 85.3kg) have attended on two occasions for familiarisation and testing. Following standardised warm-up, participants performed three maximal voluntary knee flexor isometric actions in 16 different (4 hip by 4 knee) positions on an isokinetic dynamometer. Maximal knee flexor moment and surface EMG (sEMG) activity of biceps femoris, semimembranosus, semitendinosus and vastus lateralis were recorded. Data were analysed using repeated measure two-way ANOVA. **Results:** Knee flexor moment was significantly higher at hip angles of 90, 60 and 30 compared to 0° (all $P<0.001$), and at 90 and 60° ($P<0.01$) compared to 30°. Knee flexor moment was significantly higher at knee angles of 30 and 0° ($P<0.05$) compared to 90°. Higher knee flexion angles induced significantly greater semitendinosus sEMG activity, data at 90 was greater than data at 0° across all hip angles ($P<0.05$). No significant interaction was identified between sEMG data in biceps femoris or semimembranosus with alterations in hip or knee angle. **Discussion:** Preliminary data identified increased force production at increased angles of hip flexion and decreased angles of knee flexion. Interestingly, this did not correspond with increased sEMG activity from the knee flexor musculature, with semitendinosus showing increased sEMG at higher knee flexion angles.

SCI 98 Correlation of linear ankle velocity, ball velocity and range of motion of the tension arc during the maximal instep kick

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Introduction: Linear ankle velocity at ball impact seems a good indicator of ball velocity during the instep kick. It is unknown whether range of motion (ROM) contributes to maximal ball velocity (MaxBalVel). The aim was to study the correlation between maximal linear velocity of the ankle (MaxLinVelAnk) and maximal ball velocity (MaxBalVel) and between MaxLinVelAnk and ROM of the tension arc (TA). **Methods:** Twelve male skilled footballers performed two maximal instep kicks. VICON analysis was used to measure ROM of body segments and MaxLinVelAnk. A speedometer registered MaxBalVel. ROM TA was calculated by summing up degrees of ROM of body segments. This concerned spine extension and rotation, pelvic anterior tilt and posterior rotation and kicking knee flexion and hip extension. Correlations between MaxLinVelAnk, ROM and MaxBalVel were determined. Level of significance was set at $P=0.05$. **Results:** Mean value MaxLinVelAnkle was 15.6 (SD±1.4) m/s. Mean value MaxBalVel was 98.9 (SD±9.1) km.hr⁻¹. Mean value ROM TA was 158 (SD±11) degrees. MaxLinVelAnkle correlated moderate with MaxBalVel (Pearson's $r=0.66$). MaxLinVelAnkle correlated moderate with ROM TA ($r=0.59$). All correlations were significant ($P<0.05$). **Conclusion:** MaxLinVelAnkle correlates moderate to MaxBalVel and ROM TA. ROM TA does relate to ball velocity but further research should investigate which exact role ROM plays in performance or injury prevention during the maximal instep kick.

SCI 99 Timing of body segment actions during the maximal instep kick.

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Introduction: Maximal kicking is compromised in footballers with groin pain. While kicking, body segments exhibit range of motion (ROM), velocity, acceleration and deceleration. The timing of upper body segments actions (BodSegAct) is unknown. The aim was to study timing of maximal values of BodSegAct related to four key points. **Methods:** Twenty male skilled footballers performed two maximal instep kicks. VICON analysis was used to measure ROM, maximum angular velocity (MaxAngVel), maximum angular acceleration (MaxAng Acc) and deceleration (MaxAngDcl) of body segments on maximal hip extension (MaxHipExt), maximal knee flexion (MaxKnFlex), 90° knee flexion (KnFlex90) and ball impact (Blmp). These are displayed as a percentage of the total kick. The timing of maximal values of segment variables on four key points was examined. **Results:** Maximal ROM arm extension at the non-kick side (NonKS) occurred at MaxHipExt at 51(SD±5)%. MaxAng Acc of spine flexion and MaxAng Acc of pelvic posterior tilt occurred at MaxKnFlex at 64(SD±5)%. MaxAngVel of spine and arm flexion (NonKS), MaxAngDcl of hip flexion and MaxAng Acc knee extension occurred at KF90 at 69(SD±5)%. Maximal ROM of hip extension and pelvic rotation and MaxAngDcl of spine flexion and pelvic rotation occurred on Blmp at 75(SD±5)%. Timing of key points and BodSegAct correlated significantly ($P<0.05$). **Conclusion:** This study demonstrates that kicking leg and upper body segment actions appear consistent. This information can be the basis for further studies to better understand the effect of groin pain on coordination of the instep kick.

SCI 100 Range of motion kinematics of body segments during submaximal and maximal instep kick*Langhout R, van der Westen R, Tak I & Lenssen T**Physiotherapy Dukenburg Nijmegen, Nijmegen, The Netherlands*

Introduction: Groin pain affects the ability to kick a ball with maximal power and reduces the range of motion (ROM) of the tension arc, a full body bow formed during the backswing. Whether ROM relates to ball velocity is unknown. The aim was to determine ROM of body segments changes in the submaximal (SubK=75% ball velocity) and maximal (MaxK=100% ball velocity) kick. **Methods:** Fifteen male skilled footballers performed two SubK and MaxK. VICON analysis was used to calculate ROM of spine, kicking hip and knee for four key points. Key points were defined as maximal hip extension (MaxHipExt), maximal knee flexion (MaxKnFlex), 90° knee flexion (KnFlex90) and ball impact (Blmp). **Results:** ROM on MaxHipExt for SubK/MaxK was for spine flexion (SpFlex) $-0.9(\text{SD}\pm 8)^\circ/-3.8(\text{SD}\pm 7)^\circ$, for spine rotation (SpRot) $-12.9(\text{SD}\pm 6)^\circ/-21.4(\text{SD}\pm 7)^\circ$, for hip flexion (HipFlex) $-22.8(\text{SD}\pm 8)^\circ/-31.8(\text{SD}\pm 6)^\circ$ and for hip rotation (HipRot) $-4.0(\text{SD}\pm 9)^\circ/-9.6(\text{SD}\pm 10)^\circ$. ROM on MaxKnFlex for SubK/MaxK appeared for knee flexion (KnFlex) $92.8(\text{SD}\pm 9)^\circ/111.1(\text{SD}\pm 7)^\circ$. ROM on KnFlex90 for SubK/MaxK was for SpFlex $9.6(\text{SD}\pm 9)^\circ/24.2(\text{SD}\pm 11)^\circ$, for SpRot $0.3(\text{SD}\pm 6)^\circ/4.3(\text{SD}\pm 7)^\circ$ and for HipFlex $-0.9(\text{SD}\pm 10)^\circ/6.7(\text{SD}\pm 10)^\circ$. ROM on Blmp for SubK/MaxK was for SpFlex $22.4(\text{SD}\pm 8)^\circ/41.4(\text{SD}\pm 9)^\circ$, for SpRot $9.4(\text{SD}\pm 8)^\circ/12.4(\text{SD}\pm 6)^\circ$ and HipFlex $11.8(\text{SD}\pm 9)^\circ/6.4(\text{SD}\pm 11)^\circ$. All differences between SubK and MaxK were significant ($P<0.05$). **Conclusion:** This study demonstrates that ROM is related to ball velocity. Higher ball velocity relates to greater ROM. Future studies should investigate whether reduced ROM of the tension arc could be a risk factor for groin pain in maximal kicking.

SCI 101 Reversed hip motion at ball impact during the maximal instep kick; a safety mechanism?*Langhout R, van der Westen R, Weber M & Tak I**Physiotherapy Dukenburg Nijmegen, Nijmegen, The Netherlands*

Introduction: The kicking leg demonstrates a whip-like motion towards the ball in kicking. In maximal kicking, hip flexor injury may occur at ball impact. The aim was to study hip kinematics in the acceleration phase of the submaximal (SubK=75% ball velocity) and maximal (MaxK=100% ball velocity) kick. **Methods:** Fifteen male skilled footballers performed two SubK and MaxK. VICON analysis was used to calculate range of motion (ROM) and angular velocity (AngVel) of hip flexion (HipFlex) at both 90° knee flexion (KnFlex90) and ball impact (Blmp). **Results:** At KnFlex90 for SubK/MaxK ROM for HipFlex was $-0.9(\text{SD}\pm 10)^\circ/6.7(\text{SD}\pm 10)^\circ$ and AngVel was for HipFlex $344.1(\text{SD}\pm 59.2)$ degrees/second (degs-1)/ $180.0(\text{SD}\pm 129.0)$ degs-1. ROM at Blmp for SubK/MaxK for HipFlex was $11.8(\text{SD}\pm 9)^\circ/6.4(\text{SD}\pm 11)^\circ$ and AngVel was for HipFlex $114.8(\text{SD}\pm 67.7)$ degs-1/ $-26.3(\text{SD}\pm 141.1)$ degs-1. All differences between SubK and MaxK were significant ($P<0.05$). **Conclusion:** This study shows that in maximal kicking the hip demonstrates a reversed movement and velocity to extension at ball impact. Further research should elucidate if this could serve as a safety mechanism for groin injury.

SCI 110 Association between range of motion of the backswing and velocity of kicking leg and trunk in leg cocking during the maximal soccer instep kick*Langhout R, Weber M, Tak I & Lenssen T**Physiotherapy Dukenburg Nijmegen, Nijmegen, The Netherlands*

Introduction: During leg cocking kicking leg hip and trunk reaches maximal velocities. It is unknown how range of motion (ROM) of the backswing (RomBacSw) is related to maximal angular velocity (MaxAngVel) of hip and spine. The aim was to study correlations between RomBacSw and MaxAngVel hip flexion (HipFlex), spine flexion (SpinFlex) and spine rotation (SpinRot). **Methods:** Twelve male skilled footballers performed two maximal instep kicks. VICON analysis was used to measure RomBacSw and MaxAngVel of HipFlex, SpinFlex and SpinRot. RomBacSw was calculated by summing up degrees of ROM of body segments: spine extension and rotation, pelvic anterior tilt and posterior rotation, kicking knee flexion and hip extension. Correlations between ROM and MaxAngVel HipFl, SpinFlex and SpinRot were determined. Level of significance was set at $P=0.05$. **Results:** RomBacSw correlated with MaxAngVel HipFlex (Pearson's $r=0.59$) ($P=0.036$), SpinFlex ($r=0.62$) ($P=0.033$) and spine rotation ($r=0.76$) ($P=0.004$). **Conclusion:** RomBacSw correlates moderately to MaxAngVel HipFlex and SpinFlex and strongly to MaxAngVel SpinRot. Further research should investigate the exact role ROM plays in performance or injury prevention during the maximal soccer instep kick.

SCI 125 Biomechanics of running in athletes with previous hamstring injury: a case-control study

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Introduction: Hamstring injury is prevalent with persistently high re-injury rates. The biomechanical features associated with prior hamstring injury have been inadequately explored. We aimed to inform hamstring re-injury prevention by exploring the electromyographic and kinematic characteristics of running in athletes with previous hamstring injury **Methods:** This was a case-control (Level 3b). Nine elite male Gaelic games athletes with a history of resolved hamstring injury and eight closely matched control participants sprinted on a treadmill. Lower limb kinematics and muscle activity of the previously injured biceps femoris, bilateral gluteus maximus, lumbar erector spinae, rectus femoris and external oblique were recorded. Inter-group comparisons of muscle activation ratios and joint movements were performed. **Results:** Previously injured athletes demonstrated significantly reduced biceps femoris muscle activation ratios with respect to: ipsilateral gluteus maximus (-2.5%, $P < 0.03$, $t > 2.3$), ipsilateral erector spinae (-12.5%, $P < 0.03$, $t > 2.4$), ipsilateral external oblique (-23%, $P > 0.05$, $t > 2.2$) and contralateral rectus femoris (-22%, $P < 0.05$, $t > 2.2$) in the late swing phase of sprinting. Significant sagittal plane movement asymmetries occurred at the hip (8°, $P < 0.05$, $t > 2.2$) and pelvis (4°, $P < 0.05$, $t > 2.2$) during the late swing in previously injured athletes. Increased medial rotation of the knee (6°, $P < 0.05$, $t > 2.2$) on the previously injured limb occurred at foot contact. **Conclusion:** Previous hamstring injury is associated with altered biceps femoris associated muscle activity during the critical late swing phase and altered movement patterns that effectively lengthen the hamstring. The presence of these factors may contribute to injury recurrence and should be considered during rehabilitation.

SCI 142 Comparison of lower limb EMG activity during exercise on cycle ergometer, elliptical trainer and treadmill

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Introduction: Alternative low-impact training methods are frequently used by athletes, for cross-training or during rehabilitation. While these modalities, like running, involve cyclical patterns, it is possible that neuromuscular movement patterns vary significantly. How patterns differ is important to ensure that running motor patterns and efficiency are maintained. This study evaluated similarity between elliptical cross-trainer, cycle ergometer and treadmill running from a lower limb EMG perspective. **Methods:** Competitive male runners ($n=12$, mean \pm SD; 27 ± 5 yr, mass 77 ± 8 kg) completed randomised incremental tests to exhaustion on all three modalities separated by ~ 48 h. An additional EMG testing session at two sub-maximal loads (60 and 80% VO_{2R}) was performed; surface EMG data were recorded from gluteus maximus, vastus lateralis, semitendinosus and gastrocnemius. Discrete rmsEMG envelopes, relative to a fixed kinematic point of maximal hip flexion, at both exercise intensities were created. Mean decile data across intensity and modality was analysed using a 2-way repeated measures ANOVA, $P < 0.05$ inferred significance. **Results:** Analysis revealed that activity in gastrocnemius was significantly greater on treadmill vs. cross-trainer at 60 and 80%VO_{2R} ($P < 0.001$), and on cycle ergometer vs. cross-trainer at 80%VO_{2R} ($P < 0.05$). Mean semitendinosus activity was significantly greater on treadmill vs. cycle ergometer and elliptical cross-trainer at both 60%VO_{2R} ($P < 0.05$) and 80%VO_{2R} ($P < 0.01$). Within temporally synchronised cycles, differences were present for all muscle groups; in particular gastrocnemius and semitendinosus. When running, semitendinosus recorded significantly ($P < 0.001$) greater activity from 80 to 10% of the cycle compared to the other investigated modalities, however, gluteal maximus was well matched with cross-trainer data. **Discussion:** Frequent usage of elliptical cross-training could potentially lead to deconditioning of gastrocnemius and semitendinosus, leading to altered neuromuscular patterns whilst running. This could pre-dispose an athlete to re-injury upon return to sport, however, similarity in gluteal muscle data is a positive factor from a rehabilitation perspective.

SCI 146 The effects of fatigue on peak torque, muscle stiffness, and musculoarticular stiffness of the knee joint in young male and female athletes

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Introduction: Fatigue related changes and differences in muscle strength, muscle stiffness (MS) and musculoarticular stiffness (MAS) may be responsible for disproportionate prevalence of lower limb injuries observed among genders. Thus, the aim of the study was to investigate the influence of fatigue and gender on the aforementioned biomechanical parameters. **Methods:** Twenty-two male (age = 26.7 ± 2.6 years, height = 177.2 ± 6.6 cm, weight = 72.6 ± 9.1 kg) and twenty-three female recreational athletes (age = 23.7 ± 4.2 years,

height = 164.2 ± 7.5 cm, weight = 62.3 ± 12.1 kg) participated. Peak torque of the knee joint extensor was assessed on an isokinetic dynamometer, MS of the vastus lateralis was measured using a Myoton-3 in both relaxed and contracted conditions, and MAS of the knee joint was obtained via the free oscillation technique. These measures were performed before and after a specifically developed cycle ergometer fatiguing protocol. **Results:** The multivariate results were significant for both gender [$F=28.56$, $P<.001$, $\eta_p^2= 0.74$] and time [$F=22.45$, $P<.001$, $\eta_p^2= 0.69$]. Females showed less peak torque [$F =29.60$, $P<.001$, $\eta_p^2= 0.41$ -pre; $F =17.86$, $P<.001$, $\eta_p^2= 0.29$ -post], relaxed MS [$F =46.22$, $P<.001$, $\eta_p^2= 0.52$ -pre; $F =51.44$, $P<.001$, $\eta_p^2= 0.55$ -post], contracted MS [$F =47.84$, $P<.001$, $\eta_p^2= 0.53$ -pre; $F =56.59$, $P<.001$, $\eta_p^2= 0.57$ -post] and MAS [$F =7.07$, $P=.011$, $\eta_p^2= 0.14$ -pre; $F =13.51$, $P=.001$, $\eta_p^2= 0.24$ -post] than males pre and post fatigue. Peak torque [$F =19.68$, $P<.001$, $\eta_p^2= 0.31$] and MAS [$F =12.08$, $P=.001$, $\eta_p^2= 0.22$] decreased while relaxed MS [$F=80.48$, $P<.001$, $\eta_p^2= 0.65$] and contracted MS [$F=18.67$, $P<.001$, $\eta_p^2= 0.30$] increased in both genders after fatigue. **Conclusions:** The observed gender differences and fatigue induced changes in these biomechanical parameters may contribute to the higher prevalence of knee joint injury in female athletes and more post-fatigue knee injuries in both genders.

SCI 149 The effect of a six week balance training program on postural stability

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Introduction: Ankle proprioception is critical to the dynamic balance of the body during many functional activities such as; walking, standing, and running. Study Aims: To determine if the use of a 6 week balance training program will improve postural stability, and determine gender differences and latency effects in postural stability. **Methods:** A convenience sample of forty-nine participants (27 females and 22 males) participated in the study (age = 19.98 ± 1.39 years, height = 181.48 ± 12.79 cm, mass = 384.96 ± 84.11 kg). Participants volunteered from the men's basketball, women's basketball, women's soccer, and men's track teams respectively. The men and women's basketball teams were placed into the intervention group and the women's soccer and men's track teams were placed in the control group. Both the intervention and control group were baseline tested on the NeuroCom®VSR™-Sport (NeuroCom, Clackamas, OR) using the Stability Evaluation Test (SET) testing procedures. Following the baseline testing the intervention group completed a 6-week balance-training program. **Results:** In the control groups, there was no significant change in postural stability composite score from baseline to post intervention. The postural stability composite score was reduced/improved in both the male and female intervention groups (-0.19 ± 0.24 and -0.39 ± 0.42 respectively; $P<0.05$). Post-intervention, no differences in postural stability composite scores existed between genders. There was a significant change in the intervention group postural stability composite scores from post-intervention to 2 weeks post-intervention. Postural stability significantly improved from post-intervention to 4 weeks post-intervention; however, stability did not change significantly between the 2 and 4 weeks post-intervention. **Conclusion:** Postural stability was positively associated with 6 weeks of balance training in both male and female basketball players. Changes were also observed after the completion of the intervention which indicates a latency effect of the intervention.

TOR 5 Prevalence of femoro-acetabular impingement in top flight GAA players and hip arthritis in retired players*Ní Mhéalóid A, Murphy T, & Mulhall K**Mater Misericordiae University Hospital, Dublin, Ireland*

Introduction: Many former high level Gaelic Athletic Association (GAA) players present later in life with disabling hip arthritis requiring surgery, which, in a lot of cases is due femoro-acetabular impingement (FAI). This condition results from abnormal abutment of the femoral head-neck junction with the acetabulum resulting in pain and progressive hip dysfunction. The prevalence is estimated at 10-15% in the general population, however it appears to be more common in young athletic males, and patients in their 20's and 30's with increased sporting activity. There has been an increase in the number of current players presenting with often poorly understood hip symptoms. We aimed to determine the prevalence of FAI in current top flight GAA players and in a cohort of past players. **Methods:** Clinical case series involving 92 current players and 8 retired players. Questionnaires were distributed at training sessions and via e-mail. These consisted of a general questionnaire aimed at symptoms of interest, the Oxford Hip Scale and the Tegner Activity Level Scale. **Results:** Over 50% of current players experience hip symptoms. Of those, up to half trained at reduced intensity with a further 20% missing training on a regular basis. 5 players in particular ceased playing for a period of between 3 and 36 months. Only 59 of 92 current players scored zero on the Oxford Hip Scale indicating a significant proportion have problems on a daily basis. 12 current players underwent surgical procedures including Gilmore's groin repair, adductor tenotomy or hip arthroscopy. **Conclusion:** It is evident that there is a link between hip symptoms in current players and FAI. Many hip conditions were previously unrecognised and thus left untreated, resulting in premature retirement. Players should be assessed for FAI at a young age and training regimes should be altered accordingly.

TOR 72 Epidemiology of injury in sprint distance adventure racing*Keohane D, Falvey E, O'Neill D & Cronin O**School of Medicine, University College Cork, Ireland*

Introduction: Sprint Distance Adventure Racing is a multisport activity that has seen exponential growth over the past decade. Despite this, there is currently no published medical literature describing the epidemiology of injury within the sport. This research aimed to describe the epidemiology of injury, as well as explore the demographics and anthropometrics of the athletic cohort in question. By describing the nature of injury as well as its anatomical distribution as well as how the injuries occurred, it was hypothesised that recommendations promoting optimal performance and participation in the sport could be created. **Methods:** This research was a retrospective descriptive epidemiological study of 257 Irish Adventure Racing Athletes who competed in a premier event in the Irish adventure-racing calendar. Data was collected via a questionnaire distributed by race organisers post event, detailing training habits, competitive history and injury records occurring both in and out of competition throughout the 2013 racing season. **Results:** 59.9% of the group reported injury, with over 80% of the injuries attributed to running as a discipline. 70% of injuries occurred during training and 58.6% were chronic/stress/overuse in nature. The lower limb accounted for 74% of all injuries recorded and the mean recovery time post injury was 31.4 days. The ankle and the knee cumulatively represented 32.7% of all injury. 58% of injuries reported required input from a medical professional. **Conclusions:** Injury rates are high in sprint distance adventure racing. The injuries sustained are consistent across the entire cohort of athletes, occur in a predictable fashion and are associated with significant disability. Recovery time post injury is often substantial and the majority of athletes seek professional medical assistance. Injury in itself is an independent risk factor for subsequent musculoskeletal insult, however in some athletes, exposure in terms of training and participation can be protective.

TOR 73 An evaluation of ultrasound as a method of determining body fat percentage in athletes*O'Neill D, Cronin O, Keohane D & Falvey E**School of Medicine, University College Cork, Ireland*

Introduction: As athletes endeavour for a competitive edge attention can be focused on body fat percentage (BF%) as a modifiable trait to optimize performance. As a result many athletes especially in weight sensitive sports are at risk of the deleterious effects of extremely low body fat. Changes in body mass and alterations in body composition should be followed for an accurate assessment of the health risks associated with pre-competition manipulation of body mass. The aim of this study is to evaluate if ultrasound (US) can be used as a field tool to assess body fat and by doing so evaluate if US is more effective than skin callipers in determining body fat percentage. **Methods:** BF% assessment of 67 athletes was performed using 3 methods. Skin callipers

measurements were taken at 7 International Society for the Advancement of Kinanthropometry approved sites. Dual energy x-ray absorptiometry (DEXA) was used as the clinical standard. Our novel US technique was used to assess subcutaneous adipose tissue at multiple anatomical sites, which was then compared to the other methods. **Results:** Measurement of subcutaneous adipose tissue at four anatomical sites- biceps, triceps, supraspinale and thigh, were strongly correlated with BF% from DEXA, $R^2=0.879$. An equation to predict BF% was developed. Mean BF% predicted by ultrasound showed no significant difference from DEXA (16.86%), however mean BF% by skin callipers was 14.67% which was significantly different to DEXA $P=0.000$. **Conclusion:** This study has shown that ultrasound measurements are strongly associated with total BF%. This technique provides a new and alternative field method for prediction of BF%. In comparison to skin callipers US can be more accurate than skin callipers in predicting the BF% of our athletic cohort.

TOR 96 Does hip arthroscopy work? Results of 1000 consecutive labral repairs for the treatment of femoro-acetabular impingement (FAI)

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Introduction: Labral repair in conjunction with bony deformity correction has demonstrated superior results to labral debridement in the management of FAI. Limited publications are available on a large number of consecutive labral repairs for the treatment of FAI. One thousand consecutive labral repairs and early clinical outcome are presented. **Methods:** Patients who underwent arthroscopic bony deformity correction with labral repair for the treatment of pincer or mixed FAI between September 2008 to June 2014, were assessed prospectively using internationally validated scoring systems preoperatively and postoperatively at a minimum of 1 year. Non-parametric data analysis was utilised to examine the significance of early clinical results. A P value of <0.05 was considered significant. **Results:** In total, 1000 procedures were performed during this period (pre-op, $n=987$); 810 cases were male with average age of 30.5 (15.3– 72.7) years and 190 cases were female with average age of 37.8 (14.6 – 71.5) years. Highly significant improvement in all measures of postoperative outcome was observed at minimum 1 year ($n=558$) following surgery ($P<0.005$), with average follow-up of 17 months. The Harris Hip Score increased from a median preoperative score of 78 (IQR: 70 – 88) to a post-operative score of 96 (87 – 100) at minimum 1 year; SF36 increased from 73 (60 – 85) to 91 (80 – 95); UCLA activity level increased from 6 (5 – 9) to 9 (7 – 10); WOMAC decreased from 18 (32 – 7) to 3 (11 – 0). 2.9% of cases required conversion to total hip replacement; 5.7% had repeat surgery; 7.6% had temporary mild numbness. **Conclusion:** Labral repair in conjunction with bony deformity correction has shown to be an effective treatment for pincer or mixed FAI. Excellent post-operative outcomes can be expected at minimum one year, with low complication rates.

TOR 106 The management of inguinal disruption (Gilmore's groin) in the presence of underlying femoro-acetabular impingement in competitive sportsmen

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Introduction: The diagnosis and management of chronic groin pain in competitive sportsmen can be challenging yet rewarding; Inguinal Disruption (ID) and Femoro-acetabular Impingement (FAI) are well recognised as a major cause of groin pain in athletes. The relationship between ID and underlying FAI remains unclear. A cohort of competitive sportsmen with dual pathology underwent clinical outcome evaluation following surgery. **Methods:** Over a 4.5-year period (Jan 2010 to June 2014) all male competitive athletes under 40 years old were assessed for the presence of ID and FAI. All patients with dual pathology who underwent arthroscopic management of FAI were assessed preoperatively, at 3-months and minimum 1-year postoperatively using internationally validated outcomes scores. Non-parametric data analysis was utilised with a p -value <0.05 considered significant. **Results:** 121 cases (96 patients), mean age 26 (18-39) underwent arthroscopic surgery and had clinical signs of ID. 86 cases completed 3mth and 68 minimum 1-year (mean 19 months) follow-up. The HHS increased from median pre-operative score of 83 (IQR: 73-93) to 96 (86-98) at 3mth, and to 100 (92-100) at min 1-year; UCLA activity increased from 7 (5-9.75) to 9 (6-9) at 3 mth and 10 (7-10) at min 1-year; WOMAC reduced from 18 (29-8) to 5 (16-1) at 3 mth and 3 (7-0) at min 1-year; and the SF-36 increased from 68 (60-83) to 83 (71-92) at 3 mth, and 91 (82-95) at min 1-year. Improvement in outcome was statistically significant for all measures. In 8 cases, hip surgery failed to resolve the groin pain and a groin repair was performed. **Conclusion:** Excellent results can be expected by managing the FAI component alone. Groin repair surgery should be reserved for sportsmen in whom FAI has been excluded or those who have failed to improve following arthroscopic treatment of underlying FAI.

TOR 119 Total knee replacement and golf*Cronin M, Campbell J & Murray P**School of Medicine, Royal College of Surgeons of Ireland, Dublin, Ireland*

Introduction: Although the effect exercise has following total knee arthroplasty (TKA) has been well documented in previous papers, the area of playing golf post TKA is currently understudied. This paper aims to investigate the area of golf in TKA patients and the effect that the operation has on that patient's relationship with golf. **Methods:** In this project 25 subjects were interviewed through telephone questionnaires about their mobility pre and post-operatively, and about the difference in their ability to play golf before and after the operation. **Results:** In the patients interviewed 44% played golf more frequently post-op. The mean amount of holes played rose from 13.6 to 15.6. Proficiency also improved as 24% stated they scored better after the TKA. Those with leading leg TKAs experienced more pain pre-op and therefore had to modify their swing more commonly (78%), with a decreased follow through being the most common alteration (55%). The prevalence of swing technique changes in those with non-leading leg TKAs was 67.5%, with 31% stating they had a decreased backswing due to the pain in the knee. Predictably mobility improved for patients after the TKA which allowed them to walk the course more frequently (an increase from 64% to 76%) instead of using golf carts. However a noticeable amount of patients still suffered from imbalance post TKA (40%), and another group also struggled with downhill slopes (48%). Kneeling (76%) and hunkering down (56%) post-operatively were also prevalent issues in the cohort interviewed. 100% experienced pain in the knee after playing golf pre-operatively, and this was reduced to 28% post-operatively. **Conclusion:** This study shows that TKA is a beneficial operation for those patients wishing to return to golf pain free. Patients perform well post-operatively and many are able to play golf more often and with greater enjoyment.

TOR 122 An analysis of injury patterns in senior club level field hockey players, during intensive league competition*West S & Warrington G**Dublin City University, Dublin, Ireland*

Introduction: Despite the international popularity of field hockey, there is a dearth of scientific research regarding the incidence and nature of injury amongst players. The purpose of this study was to analyse the specific pattern of injuries in senior club level Irish field hockey players. **Methods:** Division 1 hockey players in the Leinster region (n=340; 156 women, 184 men) completed online surveys over a 6-week period in the competition season to monitor the pattern of injuries. A high response rate was seen, with 59% of the players completing no less than 6 of the 7 online surveys. **Results:** During the 6-week period, 19% of the players acquired some kind of injury each week with 43% of these reported injuries seen to be recurrences of past injuries. Muscle injuries were the most common type of injury reported while the most common site of injury was the lower limb, more specifically the knee and hamstring. The majority of injuries were caused in non-contact situations, and primarily occurred during matches, especially the second half. Goalkeepers possessed the highest risk of being injured despite wearing protective equipment, while the risk of injury was higher in males when compared to females. Chartered physiotherapists were reported to treat most hockey injuries (62%). **Conclusions:** A large number of strong injury patterns were established in this study. The rate of injury was attributable to the high intensity of games and training associated with the modern game, such that many injuries arose during non-contact situations, which may be somewhat preventable. It is thus suggested that injury rates can be reduced through proper conditioning of players, which should be implemented at all levels of the sport.

TOR 133 Lumbopelvic MRI findings in a cohort of elite male Gaelic footballers: A preliminary descriptive report*Ó Doinn T, Jennings C, Whyte E & Eustace S**Dublin City University, Dublin, Ireland*

Introduction: There is a growing body of literature describing the prevalence of MRI findings among various football codes. However, no research is available for Gaelic footballers. Therefore, interpreting imaging is difficult as little is known whether findings are pathognomonic of chronic groin pain, a normal response to loading, or differ from non-athlete matched controls. Purpose: To establish previously undefined norms of lumbopelvic MRI findings among this population. **Methods:** Fifty-nine elite male Gaelic footballers were recruited from the Dublin intercounty minor (M) (n=24; age 17.35±.65), under 21 (U) (n=23; age 20.3±0.76) and senior (S) (n=14; age 23.71±2.52) panels. Subjects underwent bilateral MRI scans of the hip, sacroiliac joint, pubic bone and surrounding soft tissue. An experienced radiologist blinded to the injury status of the subjects

examined each scan. **Results:** In total, 37 (62%) subjects had an abnormal finding. Nine subjects (15%) had abnormal hip findings; 9 (15%) had cam morphologies, 3 (5.1%) had labral derangements, 4 (7%) had degenerative changes, 1 (2%) had other findings. Thirteen (22%) had abnormal soft-tissue findings; 6 (10%) had rectus-abdominis micro-tearing, 6 (10%) had adductor microtearing, 3 (5%) had other soft-tissue abnormalities. Eighteen (30%) had abnormal pubic symphysis findings; 14 (24%) had bone marrow changes or oedema, 3 (5%) had osteitis pubis, 4 (10%) had other findings. Eight (14%) had abnormal pubic bone findings; 7 (12%) had bone marrow traction changes, 1 (2%) had insertional oedema. Four (7%) had positive SIJ findings; 2 (3%) had bone marrow changes or oedema, 2 (3%) had other findings. **Conclusion:** A substantial proportion of players had abnormal lumbopelvic findings with the pubic symphysis most commonly affected. Follow-up analysis is currently underway to determine symptomatic and asymptomatic subject differences within and between the three groups.

TOR 147 An investigation into the clinical and MRI presentation of the hips of elite level academy rugby union players

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Introduction: There is a growing bank of literature identifying Femoral Acetabular impingement (FAI) and labral pathology as a common problem in the sporting population. Rugby players are loading their frames in the gym at a younger age and under greater load which involves ever increasing skeletal stresses. Screening players is vital to identify aberrant movement patterns and problematic ranges. Screening techniques in the athlete can identify those with signs consistent with FAI and at risk of chondrolabral damage. Reduced hip flexion, internal rotation and external rotations are associated with both a higher angle, and a higher incidence of large full-thickness acetabular chondral lesions. Study Aim: To investigate by MRI and clinical tests the hip alignment and tissue health of elite level academy rugby players. **Methods:** All players had a dedicated non-arthrographic 3T MRI imaging of the hip in 3 plains. The images were assessed for the presence of bony prominence at the femoral head/neck junction; oedema and cystic change at the femoral head/neck junction; alpha angle of the femoral head/neck junction; labral tearing; articular cartilage defects, subchondral oedema and cystic change in the acetabulum and femora head. Images were independently reviewed by two experienced musculoskeletal radiologists. In the case of discrepancy, a third radiologist reviewed the images. The players were clinically screened involving a battery of clinical tests and subjective questioning by an experienced physiotherapist and were compared to a matched cohort of non-elite but active males. **Results:** At analysis stage Discussion: It is hoped that by conducting such an investigation, it may help identify the extent of clinical and radiological pathology and allow us to identify risk factors. It is also hope that it would influence strength and conditioning practices.

CCP 8 Anterior capsule strain of the hip in a team handball goalkeeper: A case study

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We present a case of a 28-year-old female, team handball goalkeeper with left anterior hip pain that was exacerbated during weight bearing and sitting with the hip flexed at 90 degrees. The mechanism of injury was unknown. The patient was unable to perform squatting or lateral movements while playing team handball. Orthopaedic examination two days following onset of pain revealed a labral tear. MRI arthrogram imaging revealed no structural damage to the hip joint. Thus, diagnosis was a hip anterior capsule strain. A cortisone shot was administered and rehabilitation was prescribed. The goal of rehabilitation was to improve range of motion and lumbo-pelvic hip complex (LPHC) strength. Exercises included full body isometric holds, 4-way hip strengthening, and PNF patterns and progressed to hurdle and dynamic band drills that incorporated sport specific movements. Following 6 weeks of daily rehabilitation the patient was able to return to play with significantly reduced pain during sport specific movements. The uniqueness of the present case is that injuries to the hip are not commonly reported in the athletes participating in team handball. Team handball goalkeepers are required to make quick lateral and rotational manoeuvres as they defend the goal from high velocity shots from a distance of 6 meters. These movements may increase the forces about the hip and increase the risk of hip injury in this population. Furthermore an increased emphasis on strengthening the entire LPHC may be warranted for team handball goalkeepers in order to better stabilize the hip joint.

CCP 30 Neck pain in a 24 year-old male professional arena football athlete

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We present the case of a 24-year-old professional arena football defensive back with a history of chronic bilateral brachial plexus neuropraxia. He presented complaining of burning and tingling in both arms after a collision during a game. Initial sideline examination revealed bilateral C4-C5 dermatome paresthesia, bilateral C5 myotome weakness, and left-wrist extensor muscle fasciculation. Bilateral upper extremity reflexes were normal. No remarkable cervical point tenderness was noted. The athlete exhibited cognitive alertness, ambition to re-enter the game, and verbal resistance to emergency transportation. The athlete was excluded from participation and evaluated by a team physician within 24 hours of the initial incident. Plain radiographs revealed normal cervical vertebral alignment, normal marrow, and minor degree of congenital canal stenosis and disc protrusion at C5-C6. CT scan revealed C3-T1 facet disease, C4-C5 minor bulge, C5-C6 disc protrusion, C4-C5/C5-C6 cervical stenosis. The athlete was recommended to withdraw permanently from participation in contact sports and referred to physical therapy for the next 4 months.

CCP 39 Paget-Schroetter Syndrome in a sprinter: A case study

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We present the case of an 18 year old African American male track and field sprinter diagnosed with Paget-Schroetter Syndrome (PSS). The athlete initially presented to the athletic trainer with left posterior shoulder soreness, which decreased over three days. Initially he had no history of injury, full range of motion and strength, and 3/10 pain with and without movement in the posterior shoulder. The athlete returned on day four with increased discomfort and swelling in the upper arm, but maintained full range of motion and strength. The athlete was immediately transported to the emergency department (ED). The athlete's physical examination and radiographs were unremarkable but blood work labs indicated the D-Dimer was high at 1840 (normal range 0-399). The athlete was provided anticoagulant medication (Heparin), and scheduled for a spectral Doppler. Spectral Doppler indicated a thrombus in the left subclavian and axillary veins. The athlete was diagnosed with an upper extremity thrombosis and referred to a cardiologist with haematology specialty. The cardiologist diagnosed PSS with a note that an overdeveloped left deltoid may have precipitated the syndrome and advised removal from contact sports, continued anticoagulant medication and a venous catheter. Five days after the ED, the athlete underwent a venogram, with placement of an EKOS® thrombolysis catheter, to remove the clot. Twenty-nine days after the ED, the athlete underwent an excision of the 1st rib and release of the scalenes. A venogram verifying clot resolution was conducted 12 days post-surgery. The athlete remained inactive for 6 weeks. He participated in a running progression and was released for full participation 8 weeks post-surgery with no reoccurrence. The athlete returned sooner than consistent with current literature. This case highlights implications for clinical practice whereby practitioners should investigate activities beyond the sport specific extremity.

CCP 77 Congenital hip dysplasia in a competitive rugby player

Crement E

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I present the case of a 24 year-old competitive male rugby player. He presented with a congenital hip dysplasia causing chronic pain during hip flexion, when weight bearing, below ninety-five to one-hundred degrees. Hip special tests were negative. A video-based biomechanical analysis was performed, recording bilateral and unilateral squatting motions. Results showed that he was uncomfortable performing the tasks correctly any further than ninety-five degrees of hip flexion, and did not dorsiflex further than twenty-five degrees. An exercise-based intervention aiming to increase dorsiflexion range of motion and hip strength below ninety degrees hip-flexion was prescribed. Following the intervention, bilateral and unilateral squatting motions were re-assessed and increases in pain-free hip flexion and dorsiflexion range of motion were observed.

CCP 89 An unusual presentation to the sports injuries clinic

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We describe a case of Hereditary Motor Sensory Neuropathy Type 2 (Charcot-Marie-Tooth disease) in a 21-year-old female, presenting to a sports injuries clinic with painful ankles and difficulty running with failure to initiate a basic running training program. Diagnosed with pes cavus as an adolescent, this young lady was referred to a sports injury clinic due to an inability to return to sport. Striking clinical features included the presence of minimal calf muscle bulk, high longitudinal arches, reduced plantar flexion and absent Achilles tendon reflexes. Nerve conduction studies displayed reduced amplitude in sensory and motor responses bilaterally in her distal lower limbs. This was consistent with a diagnosis of Hereditary Motor Sensory Neuropathy type 2.

SEM 107 Gait re-training to alleviate anterior biomechanical overload syndrome of the lower limb

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Introduction: Exercise induced lower limb pain (EILP) is a commonly diagnosed overuse injury in runners both recreationally and in the military with an incidence of 27-33% of all lower leg pain presentations. The condition has proved difficult to treat conservatively, patients commonly undergo surgical decompression of the compartment by fasciotomy. This study investigates the effects of a kinematic gait retraining intervention on exercise induced lower limb pain of the anterior compartment. **Methods:** This case series examines the clinical outcome of 10 patients with exercise related running pain in the anterior compartment of the shank, after a running re-education intervention over a 6-week period. Four coaching cues aimed at increasing hip flexion and cadence, maintaining an upright torso, and achieving a mid-foot landing were used to affect gait kinematics. At initial consult and 6-week follow up, 2D analysis was used to measure kinematic data. Patients self-reported level of function and pain-free running were recorded throughout and at 1-year post intervention. **Results:** Running distance, EILP scores and patients pain improved significantly. Largest mean improvements in function were observed in running for 30 minutes or longer and reported sports participation ability with increases of 57.5% and 50%, respectively. 70% of patients were running pain-free at follow-up. Kinematic changes affected at consultation were maintained at follow-up including angle of dorsiflexion, angle of tibia at initial contact, hip flexion angle and stride length. A mean improvement of the EILP Questionnaire score of 40.3% and 49.2%, at 6 week and 1 year follow up, respectively. **Conclusions:** This represents a non-surgical successful intervention for patients with biomechanical overload syndrome of the anterior shank. Three of the four coaching cues affected lasting changes in gait kinematics. Significant improvements were shown in pain-free running times and function.

ITR 112 Evidence-based outcomes of using instrument assisted soft tissue mobilization on the treatment of Achilles tendinopathy: a single case experimental design

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Introduction: Manual therapies have been studied for efficacy in the treatment of musculotendinous pathology. Though previous studies reported successful outcomes using Instrument Assisted Soft Tissue Mobilization (IASTM), they fail to assess the effects of IASTM in isolation. The purpose of this study is to demonstrate evidence-based outcomes of IASTM in a single patient with chronic Achilles tendinopathy. **Methods:** A 37-year-old active male (180 cm; 77 kg) experiencing left Achilles tendon pain and inflammation lasting 5 months participated. Treatment consisted of 8 minutes of IASTM over the plantarflexors and Achilles tendon as per the Graston Technique® protocol every other day over a 3 week period for 8 treatment visits. Outcome measures included peak torque, passive range-of-motion, and passive plantarflexor torque assessed

on an isokinetic dynamometer (Biodex System 4). Patient-rated outcomes consisted of the Numeric Pain Rating Scale (NPRS), the Global Rating of Change (GROC), the Lower Extremity Functional Scale (LEFS), and the Disablement in the Physically Active Scale (DPAS). Each outcome measure was assessed before and after the intervention. **Results:** IASTM improved peak torque strength and passive torque extensibility in the plantarflexors to equal that of the uninvolved limb, and increased dorsiflexion range-of-motion by 6°. Disability of the extremity improved from a score of 20 to 7 on the DPAS, indicating a Minimal Clinically Important Difference. Scores from the LEFS lacked significance, but did show a gradual improvement in perceived function. Pain was decreased but according to the NPRS and GROC scales the changes in pain were not enough to make a Minimal Clinically Important Difference. **Conclusion:** IASTM is an effective intervention in the treatment of Achilles tendinopathy, correcting range-of-motion, strength, and extensibility deficits. Randomized clinical trial research is needed to further investigate the evidence of IASTM in the treatment of tendinopathies.

SEM 115 Strength and conditioning based rehabilitation of a patient with a spinal cord stimulator

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We present the case of a 47 year old man with a long history of lower back pain. He had a history of multiple operations on his back, including an L5/S1 discectomy, and a spinal cord stimulator was implanted 2 years prior to his attendance in the Sports Surgery Clinic. A CT scan in 2013 revealed degenerative changes at L5/S1, a disc bulge at L4/L5 causing moderate spinal stenosis and impingement of the L5 nerve root. Following implantation of the stimulator he saw improvements in his right-sided leg pain but developed severe left-sided leg pain. He was severely restricted in his day-to-day activities and frequent seating breaks were required to avoid prolonged standing. On initial assessment in the gym, he was only able to walk 15 metres before needing to take a seat to help relieve pain. He had a "flexion dominant" standing posture, which persisted with dynamic postures such as walking and sit-to-stand movements; the latter requiring significant upper body use to lift himself up. He also demonstrated a limited ability to utilise his gluteal muscles while extend his hip. His initial training was focused on prone hip extension, development of a hip hinge movement in his squat pattern and on adopting a more upright walking gait. Over the course of the following 6 months, with input every 4-6 weeks, he graduated to a posterior chain-focused strength training program. This program included deadlifts, squats, split squats, step ups, push-and-pull and core strength exercises. This patient is now pain-free and back to his normal activities.

ITR 120 Musculoskeletal ultrasound imaging in a patient with Achilles tendinopathy: An evidence-based approach supporting the use of Instrument Assisted Soft Tissue Mobilization

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Introduction: Musculoskeletal ultrasound (MSUS) imaging is utilized in the diagnosis of injuries to soft-tissues. Clinicians can monitor treatment response and disease progression with MSUS by visualizing, characterizing, and quantifying structural and inflammatory changes in tissues. The purpose of this study was to evaluate the structural and inflammatory responses to Instrument Assisted Soft Tissue Mobilization (IASTM) treatments in a single subject diagnosed with Achilles tendinopathy using MSUS imaging. **Methods:** A 37-year-old recreationally active male (height 180 cm; mass 77 kg) experiencing pain and inflammation lasting 5 months on the left Achilles tendon, with a gradual increase in pain for 5 weeks prior to treatment enrolled in this study. Prior treatment consisted of regular self-treatments of ice and stretching with no improvement in pain or symptoms. Treatment intervention consisted of 8 minutes of IASTM over the plantarflexors and Achilles tendon as per the Graston Technique®. Only IASTM treatments were administered every other day over a 3 week period totalling 8 treatment visits. Outcome measures included evaluation of structural changes [cross-section area; circumference; thickness] and changes in echogenicity determined from brightness change of the injured tendon. The Achilles tendon was imaged in the sagittal and transverse planes pre- and post-treatments. **Results:** MSUS imaging showed cross-sectional area decreased 36%, thickness decreased 11% and tendon circumference decreased 12% post-intervention indicating tissue healing, normalizing to the contralateral tendon. Echogenicity increased by 9% pre-post intervention also normalizing to the contralateral tendon. **Conclusion:** Eight treatments using IASTM decreased tendon thickening and increased density of the affected tendon, demonstrating support for its use in treating Achilles tendinopathies. This research demonstrates further need to investigate structural tendon properties after application of IASTM in a larger clinical population.

SEM 14 The effect of fatigue on King-Devick scores in female athletes.

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Introduction: Sports concussion is a major health issue for athletes, coaches and management. Optimal outcomes are based on immediate and accurate assessments. Regardless of the consensus statement, there are still several grey areas. This offers scope for the application of new tools in the diagnosis and management of concussion. The King-Devick [KD] test has been established as a quick and reliable sideline tool for concussion diagnosis. An increase of three seconds or more from baseline in the test indicates the need for further assessment and concussion. However, concussive symptoms can also present when fatigued. So, it is important to establish how fatigue affects the test. **Objective:** The aim of this study was to establish if fatigue influenced KD scores in non-concussed athletes. **Design:** A repeated measures design was utilised. **Methods:** 36 sports women (23 footballers, 13 lacrosse players) (mean (SD) age 21(4) y) participated. Each completed the KD test before and after a training session. **Results:** All subjects reached 15 or higher on the Borg scale. KD baseline scores were mean (SD) 41.2(7.2) seconds and 40.7(6.8) post exercise. The mean difference was 0.51 s (95% CI -1.07 to 2.01, $t=-0.653$, $P=0.518$). The majority of the participants recorded faster fatigue scores than at baseline (22/36, 16, 95% CI 0.45 to 0.75). **Conclusion:** Fatigue has some influence on KD scores. However, the majority of changes did not satisfy the 3 second decline to indicate concussion, and several subjects improved upon their baseline score. Training sessions were not standardised by time. Studies across a wider participant profile with more controlled parameters are being completed. The change in KD score with fatigue is small; lower than the 3 seconds increase stipulated for further concussion investigation.

SEM 15 Changes in King-Devick scores in male rugby players.

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Introduction: Concussion in rugby has received public attention after several high profile decisions to return to play. At present, the 20 minute SCAT3 is the gold standard diagnostic tool. Unfortunately, it is difficult to use in sports competition settings. The King-Devick [KD] is a reliable sideline assessment tool that is quicker than SCAT3, that can be administered without medical support. A wide range of symptoms present with concussion. This commonly includes fatigue or the symptoms of fatigue. Therefore it is important to establish how fatigue affects the test under various circumstances. **Objective:** The aim of this study was to establish changes in KD scores in non-concussed male athletes. **Design:** A repeated measures design was utilised. **Methods:** Experiment 1, 15 rugby union players (18-33 y), completed a KD test before and after training. Experiment 2, 32 rugby league (18-23 y), completed a KD test at pre-season, mid-season and post-season test. **Results:** Experiment 1, Post exercise, players displayed a test time 4.12 sec (95% CI 1.9 to 6.4) ($t = 3.879$, $P=0.001$) seconds quicker. From 16 players, 14 demonstrated a quicker time on retest (88%, 64 to 88). Experiment 2, KD scores were faster at mid-season (38.8(6.6) sec) than at baseline (40.2(6.6) sec) (1.39 sec, 0.211 to 2.57). Post season scores were slightly slower (39.2(7.4) sec) than mid-season, but faster than the preseason (0.93 sec, -0.55 to 2.41). **Conclusion:** Changes in KD scores have been demonstrated across a season. Improvements in both short and long-term KD scores were identified. The symptoms of fatigue over time are, like concussion complicated. As the two present with inter-related symptoms it is important to examine the changes in KD due to fatigue. Any negative change that did occur did not present as more than 3 seconds, the threshold for concussion.

ITR 19 To determine the test-retest reliability of the lateral rebound hop (LRH) test in a cohort of male collegiate athletes involved in field based sports: a preliminary report.

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Introduction: Frontal plane hip muscular deficits have been found to be a risk factor in the development of hip and groin injuries in sports involving rapid multi-directional changes in direction such as the side-cutting manoeuvre. Assessment for such deficits generally requires advanced and expensive technology. Therefore functional hop tests have been developed to assess the frontal plane control of the hip. However, many of these involve repeated unilateral movements and therefore do not mimic the cutting technique observed in field sports. The lateral rebound hop (LRH) requires the athlete to stand on one leg, jump as far as possible to the opposite side landing on the contralateral limb and immediately rebound back towards the starting point. The score is the rebound jump divided by the initial jump. This may better simulate cutting activities in sport and therefore be used in future prospective studies. In order for this to be the case, the LRH must be demonstrated to be a reliable test. **Methods:** Fifteen male (age: 20.20±5.34 years; height: 175.34±44.04cm;

weight: 78.57±22.44kg) collegiate athletes volunteered. Participants performed the LRH test bilaterally, during two testing sessions separated by ~3 ± 1 hours. Reliability data was analysed through repeated measures analysis testing. **Results:** Analysis demonstrated an ICC value of 0.77 (95% CI = 0.52-0.89) and an SEM value of 5.16% for the LRH test. There was no statistically significant difference ($P=0.91$) in scores between session 1 (95.37%±6.09) and session 2 (95.19%±5.82). **Conclusions:** These results indicate that the LRH test is reliable. This test may be a useful method of assessing the functional performance of athletes participating in multi-directional field based sports. Further research should investigate its relationship with other factors including; hip strength, injury and response to rehabilitation.

SCI 29 The effectiveness of selected tools on removal time and efficacy of the Riddell quick release face guard attachment system

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Introduction: The NATA Position Statement 'Acute Management of the Cervical Spine-Injured Athlete', states that the recommended technique for face-mask (FM) removal is the one that 'creates the least head and neck motion, is performed most quickly, is the least difficult, and carries the least chance of failure'. Recent modifications to American football helmets and their associated face-mask attachment systems like the Riddell Quick Release (QR) System positively influence removal time and access to the athlete's airway. Study Aims: To examine the effectiveness of selected FM tools on removal time and efficacy of the QR side clips after one season of NCAA Division II Football. **Methods:** A total of eighty-two American football helmets and 164 QR side clips were tested to determine time of face-mask removal and failure rate. Effectiveness of removal was assessed using three tools; (1) QR Tool, (2) FMxtractor Tool and a (3) Ballpoint pen. **Results:** Overall success rate of QR side clip removal was 92.7% (152/164). By tool, findings varied: QR Tool (100%), ballpoint pen (96.4%) and FMxtractor (80.2%). Side Clip failure rate was reported at 7.3%. There was no significant difference found in removal time ($P=.90$) between the three tools. Average time to removal was 21.2 sec (QR), 11.40 (Ballpoint Pen) and 18.20 (FMxtractor). **Discussion:** The results of this study are consistent with two previous investigations suggesting that a 6-8% failure rate should be expected and may delay access to the helmeted athlete's airway. Therefore, athletic trainers and therapists must adopt a multiple tool approach and practice secondary strategies in order to ensure quick access to airway of these athletes.

SEM 33 Repetitive commotio spinalis in a football player

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We present the case of a 21-year old African American male football player who incurred repetitive commotio spinalis (CS) episodes over a 3 year period and continued to participate. Each episode resulted in complete resolution of symptoms, whereas the athlete was evaluated on field for spinal cord injury through a neural assessment. For all episodes numbness and tingling resolved within 10 minutes resulting in an unremarkable examination thereafter with regard to strength, ROM and sensation in all the extremities. He initially experienced transient paralysis lasting less than 2 minutes after a collision with an opponent, resulting in a "pile-up," during a spring game. History indicated he incurred one previous episode with complete neurological recovery. The athlete was transported to the emergency department where an examination and MRI were unremarkable. The athlete was evaluated by a neural specialist who diagnosed CS, and cleared him for full activity. Six months after the initial evaluation the athlete incurred an additional episode due to a collision with an opponent lasting longer than 10 minutes with resolution of motor and sensory deprivation. One year after the second incidence, the athlete incurred a fourth CS episode where his symptoms partially resolved after 5-10 seconds. The athlete walked to the sideline where full resolution occurred within 10 minutes. All four incidents of spinal concussion resulted in identical symptoms of transient paralysis lasting seconds to 10 minutes. Although he was cleared for participation after each episode, the athlete decided not to return to football after the fourth collegiate episode (5th total incident) due to the psychological stress. The risk of reoccurrence in the literature suggests no cases with permanent deficits, yet any return to participation decisions should be individually based on spinal stability, neurological normalization and resolution of soft tissue injury.

ITR 37 Dynamic balance and isometric hamstring strength in GAA players

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Introduction: Athlete screening for injury risk factors is an important component of sports medicine. Sub-optimal dynamic balance control and asymmetries in maximal voluntary isometric contraction (MVIC) are suggested to be predisposing factor for lower limb non-contact injury and hamstring muscle strain respectively. No normative data have been published for these characteristics in GAA players. Aim The purpose of this study was to describe dynamic balance and IMVC hamstring strength of male GAA players using tools applicable to a field testing environment, exploring differences between elite and sub-elite groups. **Methods:** A cross sectional study was carried out on a sample of 55 male GAA players (n=24 elite and n=31 sub-elite), who were all free from injury. Dynamic balance was measured using the Y Balance Test and hamstring MVIC was measured using a commercial sphygmomanometer (mmHg). Reach distances were standardized to limb length by calculating the maximized reach distance (%MAXD) using the formula (excursion distance/leg length) × 100 = MAXD. Subgroup comparisons were made with independent t tests. **Results:** Mean composite Y-Balance Test scores were: left leg, 94.32±4.75 cm elite and 89.16±6.87 cm sub elite ($P=0.0015$, ES=0.87); right leg, 93.88±4.52 cm elite and 87.71±7.41 cm sub elite ($P=0.005$, ES=1.0). Posteromedial and posterolateral reach on both legs was also significantly different between elite and sub-elite players ($P<0.05$). Similarly, there was a significant difference in hamstring MVIC between the player groups for both the left (239±29.93 elite, 216±24.58 sub-elite, $P=0.0015$, ES=0.84) and right legs (237.5±31.81 elite, 218.87±21.89 sub-elite, $P=0.006$, ES=0.68). **Conclusion:** These results provide reference data for YBT and hamstring MVIC. It is evident that differences exist between players participating at elite and sub-elite levels, but the relevance of this for injury risk or athletic performance remain to be investigated.

ITR 40 An investigation of the relationship between diagnosis and objective tests in the assessment of athletic groin pain

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Introduction: Athletic groin pain (AGP) accounts for 2-5% of sport related pain. Diagnosis and management of AGP relies on a thorough history and physical assessment. Hip range of motion, Adductor Squeeze Test and Crossover Test are widely used clinical indicators in the assessment of AGP. There is a dearth of research surrounding the significance of the aforementioned clinical indicators relative to specific diagnoses. Aim: To determine the relationship between the diagnosis and objective findings of the Adductor Squeeze Test, Crossover Test and hip range of motion in males with groin pain. **Methods:** Retrospective study of 40 males with groin pain diagnosed by a sports medicine consultant and assessed by a physiotherapist. The cohort were grouped according to diagnosis; anterior plate (n=26), hip (FAI) (n=7), anterior plate and hip (n=7) and symptomatic side. **Results:** A significant difference in hip internal rotation was found in subjects on their symptomatic versus non-symptomatic side ($P<0.001$) (mean 5.28 SD±4.99, mean 6.76 SD±7.06). No significant difference in hip internal rotation was found in subjects with bilateral groin pain ($P>0.001$) (mean 1.00 SD±2.24). The crossover test was found to be significantly correlated to the Adductor squeeze test at 45 degrees ($P=0.05$) but not at zero or 90 degrees ($P>0.05$). No correlation was found between diagnosis and either the Adductor squeeze tests or crossover sign ($P>0.05$). **Conclusion:** The results highlight the loss of hip internal rotation in individuals with groin pain, demonstrated by the significant asymmetry in range of motion relevant to asymptomatic side. Considering the absence of a correlation between the Adductor squeeze tests and diagnosis, the squeeze test may best used as a pain provocation test rather than a diagnostic test.

SEM45 Is PARQ+ a suitable screening tool for laboratory based maximal exercise testing?

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Introduction: Pre-participation medical evaluation of athletes (PPE); questionnaire, physical examination and ancillary tests conducted by a medical practitioner, is routine practice in our laboratory prior to exercise testing to exhaustion. In contrast many health and exercise professionals use the Physical Activity Readiness Questionnaire (PAR-Q+) alone, for pre-exercise screening. The aim of this study was to compare exclusions to laboratory based maximal exercise tests by PPE to the generic PAR-Q+. **Methods:** Athletes (n=83; male 67% female 27%; M±SD age 32±10yr, body mass 74.2±13.4kg, height 1.76±0.09m) attending for exercise testing between January and May 2014 underwent routine PPE and completed a PAR-Q+ in randomized order. PPE allowed opportunistic enquiry whereas PAR-Q+ was completed as per its written instructions. Cohen's kappa

(k) was used to analyse level of agreement between numbers of exclusions from maximal exercise by each process. **Results:** Exclusions from maximal exercise were; 16 (19%) and 14 (17%), for PPE and PAR-Q+ respectively. No complete exclusions were made on PPE; athletes were given the option of a submaximal exercise test. Of exclusions, 10 (63%) by PPE and 2 (14%) by PAR-Q+ were on the grounds of age. Levels of agreement between PAR-Q+ and PPE were poor ($k = 0.27$, 95% CI 0.02 to 0.05). Further physical examination in PPE contributed little extra to exclusion rate ($n=1$). **Discussion:** results suggest that the PAR-Q+, a generic non-medically interpreted pre-activity screening tool is not a sensitive enough tool to discriminate those athletes who might be at risk of adverse events in an exercise laboratory setting.

SCI 48 The effect of trunk range of motion on lower extremity biomechanics in athletic groin pain patients

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Introduction: Athletic Groin Pain (AGP) is particularly common in field sports and is thought to be associated with abnormal lower limb biomechanics, particularly at the hip and groin. Trunk control has an effect on lower extremity biomechanics, but this has not been investigated in AGP patients. **Study Aims:** To study the effect of trunk range of motion (ROM) on lower extremity biomechanics in AGP patients. **Methods:** Forty-one ($n=41$) elite multi-directional field sport players (mean \pm SD: age 24.6 ± 5.1 years; height 181.1 ± 5.9 cm; mass 81.9 ± 9.1 kg; Gaelic Football 63%, Soccer 15%, Rugby 13% and Hurling 10%) diagnosed with AGP were recruited to partake in a 3D biomechanical assessment. Correlations were carried out between trunk frontal ROM and hip, knee and pelvis angles and forces, and vertical ground reaction force (GRF). **Results:** 12 lower extremity biomechanical factors were significantly associated with trunk ROM. Notable significant correlations ($P<0.01$) between trunk ROM and lower extremity biomechanics included: pelvis internal/external rotation ($r=0.53$); hip resultant force ($r=-0.51$); vertical ground reaction force ($r=-0.49$); knee flexion ($r=0.48$); hip flexion angle ($r=0.46$); pelvis drop/hitch ($r=0.44$); and knee varus/valgus moment ($r=-0.41$). **Conclusion:** As trunk ROM increased there was a significant increase in lower extremity ROM, but a decrease in force production. Perhaps the body adapts a protective strategy against large forces in and around the hip and pelvis. However, there may be adverse effects to having greater ROM about the hip and pelvis during dynamic movements; greater ROM may expose localised areas to relatively excessive forces. Inability to properly transmit these forces could be a potential injury risk factor associated with AGP, while also affecting sporting performance. Further research is required to elucidate these issues.

SEM 49 To examine reliability of a unilateral mid-thigh pull test and to examine the differences in peak force generation in a unilateral versus bilateral test on two force plates

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Introduction: A bilateral isometric mid-thigh pull (MTP) has been suggested as a valid means of measuring an individuals' peak lower extremity strength. However, it could be argued that a unilateral test may provide a greater insight into the peak force generation capacity of each limb than a bilateral test on two force plates. **Aims:** To determine the test-retest reliability of a unilateral MTP and to examine the differences in peak force generation in a unilateral versus bilateral test on two plates. **Methods:** 16 subjects, 11 males and 5 females, (age: 24.9 ± 3.2 years, height: 177.4 ± 8.3 cm, mass: 75.7 ± 11.0 kg) participated in bilateral and unilateral isometric MTP testing over three separate days. Between session reliability of the unilateral MTP was assessed using an intraclass correlation coefficient (ICC), a coefficient of variation (CV) and a repeated measures ANOVA. A comparison of unilateral peak force in the unilateral and bilateral test was undertaken using paired t-tests. Data was collected using 2 AMTI force plates (BP 400600). **Results:** The unilateral MTP exhibited excellent between session reliability with an ICC score of 0.98, a CV of 0.9% and a non-significant repeated measures ANOVA ($F=1.42$, $P=0.26$). The unilateral test recorded significantly greater ($P<0.01$) peak force (2012N) compared to the bilateral test (1107N). The unilateral MTP shows a limb asymmetry of 3.8% compared to 9.2% in the bilateral test. **Discussion:** The unilateral MTP test showed to be a reliable way of measuring the maximum force capabilities of the lower limb. This test-retest reliability has not been demonstrated before. The unilateral MTP test may be a more appropriate means of testing as it records significantly greater peak force generation compared to that of the bilateral MTP. Also, the greater limb symmetry suggests a unilateral MTP provides a greater insight into peak force generating capacity.

SEM 52 Inter limb asymmetry in athletic groin pain and rugby union players

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Introduction: Inter limb asymmetry is a suggested risk factor for various lower extremity injuries. To date however, no studies have investigated if kinematic and kinetic asymmetry is important in athletic groin pain (AGP). The aim of this study is to compare asymmetry in Rugby Union (RU) players to that of AGP patients.

Methods: 15 field sports players with AGP (age, 25.6±5.3 years; height, 181.4±6.5 cm; mass, 82.7±11.8 kg; time with AGP, 50.8±70.2 weeks) and 15 elite injury free RU players, were recruited (age 20.4±1.0 years; height 186.2±7.6 cm; mass 98.4±9.9 kg). Testing involved three trials on each leg for a single leg drop landing (SLDL) (30cm) and a running cut (75°). Eight infra-red cameras (Vicon -Bonita B10, UK), synchronized with two force platforms (AMTI, BP400600, USA) collected data using Plug in Gait marker locations (Vicon, UK). Marker and force data were filtered using a fourth order Butterworth filter at 15 Hz. Peak hip, knee, and pelvis range of motion (ROM) were examined for the drop landing, with the addition of trunk ROM for the side cut. Absolute peak moments were also examined at the hip and knee for the SLDL and cut. The mean of each participant's trials were used in the analysis. Normalised inter limb asymmetry was calculated for each participant within both groups as follows: Normalised Asymmetry = (Max-Min) / [0.5 * (Max+Min)] Independent t-tests ($P < 0.05$) determined significant differences in normalised asymmetry between the groups. **Results/Discussion:** In the SLDL, the RU group demonstrated significantly greater asymmetry in hip ab/adduction moments compared to the AGP group ($P < 0.05$). All other variables displayed non-significant differences. These results suggest that asymmetry may not be important in the examination of AGP. Future research should investigate if asymmetrical hip moments are a risk factor for injury in RU.

SEM 53 The effect of foot position on trunk, pelvis and hip biomechanics in athletic groin pain populations

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Introduction: Poor neuromuscular control of the hip, pelvis and trunk during dynamic cutting activities are implicated in the development of athletic groin pain (AGP). Foot placement may be an easily modifiable factor in enhancing control during cutting but the influence of foot position on trunk, hip and pelvis biomechanics is unclear. **Aim:** To investigate the effect of foot placement angle on trunk, hip and pelvis biomechanics in AGP patients undertaking a change of direction cut. **Methods:** Forty recreational field sports players diagnosed with AGP were recruited. Participants undertook a 75° cutting manoeuvre and biomechanical data was collected using eight high speed motion cameras (Vicon) and an AMTI force plate. Measures of interest were trunk, pelvis and hip range of motion (control) and foot placement angle. Pearson correlations ($\alpha = 0.05$) were calculated to examine the relationship between foot placement angle and each biomechanical variable.

Results: There were significant ($P < 0.05$) correlations between foot placement angle and pelvis range of motion in flexion ($r = 0.59, P < 0.01$), side flexion ($r = 0.38, P = 0.02$) and rotation ($r = 0.64, P < 0.01$). In addition, there were significant correlations between foot placement angle and thorax range of motion in side flexion ($r = 0.62, P = 0.01$) and rotation ($r = -0.40, P = 0.01$). **Discussion:** This study clearly demonstrates that foot placement angle has an influence on pelvic and trunk range of motion (control) in AGP patients while cutting. This is of relevance as foot placement angle in controlled situations is an easily modifiable factor. Thus practitioners working with AGP patients in the mid-to-late phases of their rehabilitation may utilise foot placement queues in an attempt to reduce range of motion about the pelvis and trunk.

SCI 55 The effect of non-dominant lower limb training for bilateral lower limb motor performance

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Introduction: Non-dominant lower limb training has been shown to be of benefit for bilateral lower limb performance in soccer players. This study evaluated non-dominant lower limb training on lower limb motor performance in Gaelic football. **Methods:** 13 senior male club level footballers; age 18–35yr; ($M \pm SD$) height 183±4cm and body mass 78.4±7.0kg were randomly divided into intervention ($n=7$) and control ($n=6$) groups. Participants all performed a standardised set of Gaelic football drills during training session warm up for six-weeks; the intervention group used their non-dominant limb and control group the dominant limb only. Gaelic football-specific skills tests of; shooting accuracy, passing accuracy and timed soloing, were performed for both limbs pre and post intervention. **Results:** In intervention vs. control comparisons significant improvements were noted in all skills tests in the non-dominant limb ($P < 0.05$); results expressed as percentage change from

baseline were; +72% vs. -2%; +85% vs. +23%; and -20% vs. +14% for shooting score, passing score and soloing time respectively. In analysis of dominant limb results, although % change from baseline data suggested a positive influence of non-dominant limb training [+21% vs. +6%; +36% vs. +32%; and -1.81% vs. -0.26%]; changes did not reach statistical significance for any comparison ($P>0.05$). **Conclusion:** This study demonstrated beneficial effects of 6 weeks non-dominant lower limb skills training in non-dominant limb motor performance in senior male Gaelic footballers. A greater sample size and extended training period would be required, to confirm a suggested crossover benefit of non-dominant lower limb training to the dominant limb.

SCI 57 Isokinetic muscle strength protocols and return to sport criteria following anterior cruciate ligament reconstruction: a systematic review

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Introduction: Following anterior cruciate ligament reconstruction (ACLR), strength is considered a key variable in regaining full function of the knee. Isokinetic strength is used as part of the return to sport (RTS) criteria. Numerous of published studies report isokinetic dynamometry for evaluating strength following ACLR. However, a standard protocol for evaluating isokinetic muscle strength is still unclear. Aim: To review and report the isokinetic strength evaluation protocols that are currently being used following ACLR, and from this review recommend an appropriate strength evaluation protocol following ACLR in accordance with the RTS criteria. **Method:** Articles were searched using ScienceDirect, PubMed and Sage Journals Online, combined with cross-checked reference lists of the publications. Inclusion criteria: (a) participants that had undergone ACLR surgery; (b) evaluated knee flexor and extensor isokinetic muscle strength up to 24months following ACLR; (c) been published between January, 1980 and October, 2013, and (d) been published in English. Methodological data and results from the isokinetic strength evaluation protocols were extracted from each article. The RTS criteria were reviewed for each study, if mentioned. **Results:** 39 studies met the inclusion criteria and reported their isokinetic strength evaluation protocol following ACLR. The most commonly used method variables were concentric mode of contraction (82%), 60°/s angular velocity (74%), 3-5 reps (86%), 0-90 ° range of movement (ROM) (43%), and gravity correction (90%). However, only 26% of these studies reported specific strength values as part of their RTS criteria. **Conclusion:** This review found that there was no clear standardised protocol for testing isokinetic strength following ACLR and the RTS criteria varied. The review proposed a standard strength evaluation protocol of five reps of concentric knee extension and flexion at an angular velocity of 60 ° /sec at a set ROM of 0-100 ° using gravity correction.

SCI59 Analysis of the relationship between isometric and isokinetic peak torque with unilateral vertical jump height.

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Introduction: Isometric and isokinetic tests are often performed to quantify an athlete's maximal force production. However, isokinetic tests have been criticized for lacking specificity to sporting actions. Research has shown that isokinetic peak force does not positively correlate with vertical jump height. An isometric mid-thigh pull (MTP) may be a more sport specific means of measuring peak force generation. Study Aims: To examine the relationship between isometric unilateral MTP and isokinetic peak force with unilateral vertical jump height. **Methods:** 11 physically active male participants were recruited (age: 25.4±3.3 years, height: 181.1±7.3 cm, body mass: 81.45±7.84 kg). MTP and unilateral vertical jump height data was collected using 2 AMTI force plates. Concentric isokinetic knee extensor strength was collected via isokinetic dynamometer. A Pearson's coefficient correlation was used to examine relationships between unilateral MTP peak force, unilateral jump height, and isokinetic extensor strength. **Results:** There was no significant correlation between MTP peak force and jump height ($r=0.43$, $P=0.11$). In addition there was no significant correlation between isokinetic peak extensor torque and MTP peak force ($r=0.22$, $P=0.48$) or jump height ($r=0.12$, $P=0.94$). **Discussion:** While isometric MTP was hypothesized to be a more sport specific measure of peak force than isokinetic dynamometry, neither were correlated to performance outcome in a unilateral vertical jump test. Therefore, while the isometric MTP and isokinetic dynamometry appear to be valid measures of strength, they do not seem to be effective predictors of jump height. A limitation of the current study is the small number of participants ($n=11$), our findings thus need to be confirmed with a larger cohort. Future studies should examine the relationship between unilateral MTP peak force and other sport specific movements such as cutting and landing.

SEM 60 Physiological profiling of elite Gaelic footballers and its relationship with injury.

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Introduction: Evidence exists detailing the physiological profiles of elite Gaelic footballers but there is a lack of documentation exploring these physiological profiles and its correlation with injury, thus limiting the development of appropriate prevention strategies. Objectives were to establish whether a relationship exists between the physiological profiles of elite Gaelic footballers and injuries that occurs throughout a competitive playing season. **Methods:** A prospective cohort of 22 inter-county Gaelic footballers underwent baseline measurement of seven muscle function tests during pre-season and mid-season of the 2014 playing season. Injury data was collected on subjects from pre-season through to one month post mid-season testing. **Results:** Uninjured players achieved a higher Vertical Jump Test score in pre-season ($P=0.011$) and mid-season ($P=0.003$) compared to players injured. Thomas Test scores during pre-season for player's left ($P=0.018$) and right ($P=0.039$) knees were significantly lower for players injured while sprinting compared to contact injuries. There was no relationship between Sit and Reach, Passive Straight Leg Raise scores and hamstring injuries ($P>0.05$). In pre-season, calf flexibility of players impact on the grade of injury acquired later in the season. Left calf ($P=0.030$) & Right Calf ($P=0.004$) results were analysed against severity, with Grade 1 injuries having a higher result than Grade 2 bilaterally. Hamstring injury sufferers didn't improve their scores as much in mid-season testing from pre-season compared to players without hamstring injuries ($P=0.001$). In pre-season left calf flexibility was higher for non-injured players compared to injured players ($P=0.015$). **Conclusion:** Muscle function tests can be used as a predictive value as to whether a player will get injured, how they get injured and how severe the injury is. Suitable reference values in each test should be established and players should aim to achieve these values prior to the commencement of the playing season in order to decrease their risk of injury.

ITR 61 Risk factors for hip and groin injury in sport: a systematic review and meta-analysis

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Introduction: Recovery after hip and groin injury is often problematic with some athletes suffering longstanding symptoms and recurrent injury. The understanding of risk factors for injury is important in injury prevention. Aim: To systematically review the literature relating to risk factors for hip and groin injury in athletes. **Methods:** This review followed the PRISMA guidelines. Prospective studies analysing risk factors for hip and groin injury were considered for inclusion. No restrictions were made on gender or sport. Assessment of methodological quality was carried out using the CASP criterion. **Results:** N=16 studies were included (N=6289 athletes participating across 4 sports). Study quality was moderate to high. 18 risk factors were examined; in the majority of studies, risk factors were measured at a single time point prior to athletic exposure. One study measured risk factors periodically over a 9 week pre-season time-point. Pooled results showed that higher age [MD 1.87 yr (95% CI 0.93, 2.81)] and previous injury, [OR 2.32 (1.60-3.38)] were significant risk factors for hip and groin injury. Pooled results also found that injured athletes have significantly lower self-reported function [SMD 0.45 (0.22, 0.69)] and better jump height performance [MD: 1.24cm (-0.17, 2.64)] at pre-season testing. **Conclusion:** Athletes with higher age and previous injury are more at risk of hip and groin injury. Future studies should consider the cyclic nature of risk factors throughout a playing season, with a particular focus on self-reported function and jumping performance.

SEM 62 Injury incidence and profiling of a senior inter county Gaelic team

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Introduction: Gaelic football is a highly physical, contact game which leads to the occurrence of injuries and subsequent absence of players from team activities. Objectives 1.To quantify the number of injuries over the course of a competitive playing season in a senior inter-county Gaelic team 2.To establish the most common sites, causes, severity, recurrences and when and where in the season injuries occur. **Methods:** Injury data was collected and recorded on a twice weekly basis by the team physiotherapists during the playing season from pre-season (December 2013) to mid-season (June 2014) on a Senior Inter-County Gaelic panel. **Results:** Mean age of the panel was 24.3 (SD±4.3) for the 43 subjects (n=43) included in the study. 48 injuries in total were reported giving an incidence rate of 2.24 injuries per player per year. Overall, 39% (n=17) of players remained injury free while 61% (n=26) had at least one injury. Lower limb injuries were the most frequent injuries accounting for 65% of all injuries. Hamstring was the most common site of injury overall with 11 injuries (23%

of total injuries) reported. 27% (n=7) of injured players suffered recurrent injuries with hamstring the most common site of recurrence. Injuries occurred throughout the year with a noticeable increase in mid-February and late March. An acute cause comprised 81% of all injuries with contact with another player the main reason. Mild (<1 week symptoms/absence) and moderate (1-4 weeks) injuries represented 40% and 43% of injuries respectively, with 17% being severe (>4 weeks) in nature. The majority of injuries occurred during match play (60%) in this study compared to training (40%). **Conclusion:** With an increased incidence of injuries occurring in the lower limb and a significant proportion of injuries recurring, changes and improvements should be implemented in player conditioning and management.

ITR 70 Incidence of common lower limb injuries in elite male Gaelic games and associated healthcare intervention

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Introduction: Gaelic football and hurling are Ireland's national sports, with growing popularity in Australasia, North America, Canada and Europe. Little research has been carried out on the direct treatment costs of healthcare interventions post injury. This cohort study describes the incidence of common lower limb sports injuries affecting elite male Gaelic football and hurling players, and the reported frequency of medical investigations, interventions and physiotherapy treatments over 6 consecutive seasons. **Methods:** Participants were male senior inter-county Gaelic football and hurling players from teams enrolled to the National GAA Injury database (2008-2013). Teams and players were registered for each season; injury and treatment data were submitted weekly by the team doctor/Chartered physiotherapist through a secure web portal. Data were analysed using IBM SPSS Statistics 20 and Microsoft Excel, with results expressed as percentages of available totals. **Results:** Over 6 years 40 football and 28 hurling team seasons were followed, with 1300 football and 915 hurling player registrations. There were 1264 football injuries, sustained by 807 (62.1%) players and 1050 hurling injuries, incurred by 647 (70.7%) players. Lower limb injuries predominated constituting 77.7% (n=982) of Gaelic football and 68.8% (n=722) of hurling injuries. Combined, 617 injuries were documented for 423 footballers and hurlers in the pelvis/groin (n=115, 18.6%), hamstring (n=226, 36.6%), knee (n=138, 22.4%) and ankle (n=138, 22.4%). In total, 55.3% of these injuries received medical investigation/intervention; 12.8% X-ray, 10.4% MRI, 19.8% for surgical procedures. There were 3140 physiotherapy sessions recorded for these 617 injuries. **Conclusions:** These results outline the healthcare interventions, following the common injuries to the lower limb and hip/groin in elite Gaelic games. These findings have particular relevance for the GAA Injury Scheme.

SEM 78 Anthropometric characteristics of elite Gaelic football players and their relationship to injury occurrence.

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Introduction: Body composition analysis is a modern concept used to evaluate the physical characteristics of players in order to assess if they are optimally prepared physically for competition. Objectives a) to investigate the anthropometric characteristics of an inter-county football team in pre-season and mid-season. b) To determine if players' anthropometric changes throughout the season have any relationship with injury occurrence. **Methods:** 21 inter-county footballers underwent total Body Composition (bone, muscle and fat mass) measurement analysis at pre-season and mid-season using dual-energy x-ray absorptiometry (DXA scan) along with their height and weight. Injury data on players was collected and recorded twice weekly by team physiotherapists throughout the study period. **Results:** Mean age of players was 25.1 (SD±4.0). Defender's Fat Mass ($P=0.033$) and Tissue Percentage Fat ($P=0.023$) decreased significantly compared to forwards between pre-season and mid-season. Players who sustained an injury on landing ($P=0.041$) were taller versus players with contact injuries. As Percentage Lean Mass increased, the Percentage Fat Mass ($P=0.003$) and Tissue Percentage Fat ($P=0.000$) decreased. Pre-season DXA results identified that 19.0% of players had an ideal Body Fat Percentage for athletes, with 9.5% having acceptable and 71.4% above recommended values. By mid-season 85.1% of player's Fat Mass had decreased with 23.8% being ideal, 19.0% acceptable & 57.1% above recommended. Players suffering from chronic injuries had a higher Fat Mass and Tissue Percentage Fat and lower Lean Mass compared to those suffering acute and overuse injuries. Injury free players had a higher Lean Mass in pre-season than those suffering injuries. Furthermore a correlation was identified between reduction in Lean Mass and number of injuries between pre-season and mid-season. **Conclusion:** Although trends were seen between various aspects of body composition and its relationship to injury, further studies require a larger

cohort monitored over a longer time period to achieve greater statistical power.

SCI90 Physiological and performance responses to a modified Loughborough Intermittent Shuttle Test compared to match day performance in Gaelic footballers.

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Introduction: The Loughborough Intermittent Shuttle Test (LIST) is a field-based fitness test, and a validated Soccer simulation protocol. Research has shown that the LIST closely simulates the physiological and physical demands of a Soccer match. The aim of the present study is to examine whether the LIST protocol replicates the physiological and physical demands of Gaelic football, a similarly high-intensity field sport. **Methods:** 15 male senior-level club Gaelic footballers perform a 60-minute LIST protocol and a 60-minute competitive Gaelic football match, at least 7 days apart. The following physiological and performance responses are monitored on both occasions: average heart rate; average velocity; distance covered walking/ jogging/ running/ sprinting; blood lactate concentrations immediately before/midway through/immediately after the LIST protocol/match performance. **Results:** Data collection, including anthropometric measures (age, height, body mass, body fat%), has commenced and projected completion of collection is end of July. The data will be analysed by means of equivalence testing, specifically 90% confidence intervals for difference between LIST and match performance in the monitored physiological and performance measures. **Discussion:** The authors anticipate that there will be no significant difference between the LIST protocol and the Gaelic match performance for any of the monitored physiological and performance measures, demonstrating that the LIST replicates the activity pattern and physiological demands of a Gaelic football match. These findings would support the use of the LIST as an assessment tool or training drill for Gaelic football match fitness, particularly as part of pre-season training and when players are returning from injury. In addition, the anticipated findings of the present study would act as a reference for future research studies that use the LIST protocol as a substitute for match performance on Gaelic football populations.

ITR 97 A comparison of hip ranges of motion in male elite gaelic football players with and without a history of previous hip or groin injury

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Introduction: Groin injuries are common in football codes with reduced hip range of motion (ROM) and previous injury established as risk factors for subsequent groin injury. 24% of groin injuries in Australian Rules Football are re-injuries. Previous demonstration of a relationship between previous injury and reduced hip ROM suggests that reduced hip ROM following a hip or groin injury may be a risk factor for subsequent re-injury. No such relationship between reduced hip ROM and previous hip or groin injury has been investigated in Gaelic Football. Study Aims To compare hip ROM of Gaelic male footballers' previously injured limb to the uninjured limb to a control group. **Methods:** 46 male Gaelic footballers from Dublin Minor and U/21 Football Panels aged 18.95 (\pm 1.52) years volunteered for this study. 18 (17.8 \pm 1.61 years), 23 (18.31 \pm 1.25 years) self-reported previous unilateral groin injury and no previous groin injury respectively via online questionnaire. 5 participants (18.5 \pm 2.38 years) were excluded for having a current hip or groin injury. Variables analysed were hip abduction, flexion, extension, and rotation (internal, external, total). Group differences were assessed using either Kruskal Wallis or One Way ANOVA tests. Significance levels were $P < 0.05$. **Results:** Hip and groin injuries were the highest self-reported previous injury (45.7%). Kruskal-Wallis and one way ANOVA tests did not reveal any significant differences for any hip range of motion measurements between the injured limb, uninjured limb, and the control group. **Discussion:** Previous hip and groin injury is highly prevalent amongst male elite Gaelic Football players. The study suggests participants with previous hip or groin injuries regained any hip range of motion deficits during rehabilitation programmes, but further research is needed to confirm this.

ITR 103 The effect of positive pressure simulated hypogravity on spinal excitability: a pilot study

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Introduction: Positive pressure hypogravity treadmills have become a popular rehabilitation and training tool in recent years, however no information exists on its effects on spinal excitability. Through changing the parameter of gravitational load, hypogravity treadmill systems could alter neuromuscular control. Study Aims: To determine the effects of positive pressure simulated hypogravity on the standing soleus Hoffmann reflex in

healthy males. **Methods:** Seven males stood quietly on a calibrated hypogravity treadmill (AlterG M320) at normal gravity and four levels of simulated hypogravity (80%, 60%, 40%, and 20% normal gravity). Seven trials of a normalized standing soleus Hoffmann reflex were completed following a two minute acclimatization period at each of the five conditions. The trials were averaged and analysed utilizing a repeated measures ANOVA. **Results:** Mean peak-to-peak soleus Hoffmann reflex amplitudes did not change across gravitational loads (Wilks' $\Lambda = 0.51$; $F_{(1,6)} = 0.73$; $P = 0.63$). **Discussion:** In this pilot study, simulated hypogravity did not alter spinal excitability across conditions. These results could suggest that simulated hypogravity does not alter the control of movement in healthy males, however our sample was small and participants did engage in activity during testing. Future work is warranted with larger samples, refined methodologies, and varied conditions to more thoroughly understand if positive pressure hypogravity treadmill systems alter neuromuscular control.

ITR 104 The Functional Movement Screen does not predict sport related injury incidence in college female athletes.

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Introduction: The functional movement screen (FMS™) is a tool used by athletic trainers, physical therapists, and fitness professionals to identify muscle imbalances and movement limitations that may lead to injury or restrict performance in physically active subjects. It has been previously reported that athletes scoring below 15 (out of 21 points) on the screening are predicted to be at greater risk of injury during sport participation. Study Aims: To retrospectively compare FMS scores to injuries sustained in 105 female collegiate athletes. **Methods:** FMS scores were obtained as part of a pre-participation physical exam prior to the start of the 2012-2013 academic year. FMS scores were compared to the number and type of injuries reported to the medical staff and entered into the EMR system. **Results:** The mean FMS™ scores of all participants was 15.48 (± 1.66). There was not a significant correlation ($r = -0.082$, $P = 0.405$) between the total number of injuries sustained and FMS™ scores. FMS scores were dichotomized into 14 and below and 15 and above. Odds ratio's shows that athletes with an FMS™ score of 14 or below had a 2.27 increased risk of injury (95% confidence interval (CI) = 0.86-6.01) when compared to those with a score of 15 or above. However, when confidence intervals cross over the number 1, such as ours do, it suggests that any increased risk is not considered significant. Similar trends were found when injuries were subdivided into chronic or acute injuries. **Discussion:** While FMS scores potentially identify muscle imbalances and faulty movement patterns, there is little evidence that these issues lead to increased risk of injury according to our data. Our liberal definition of injury may have impacted our results while others who reported increased risk failed to correctly interpret the confidence intervals supporting their data.

SEM 121 Foot and ankle injuries in elite adult Irish dancers

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Introduction: In Irish dance, the FA are the structures most commonly injured, but there is scant research examining the potential factors placing Irish dancers at risk of sustaining FA pain and injury. Study design: An observational study examining the factors linked to foot and ankle (FA) musculoskeletal pain and injury in elite adult Irish dancers. **Methods:** The biopsychosocial characteristics of 29 subjects with no previous FA problems were compared to 53 subjects who cited the FA as their most troublesome bodily area. Subjects were allocated to "Never Troublesome" (NT) and "Most Troublesome" (MT) groups respectively. **Results:** Factors found to be statistically significant for membership of the MT group included female gender ($P = 0.004$), greater gastrocnemius flexibility ($P = 0.021$), better single leg balance ($P = 0.019$) and a higher number of endurance jumps ($P = 0.009$). The MT group reported more severe levels of day to day pain ($P = 0.038$) greater bothersomeness of daily pain ($P = 0.005$), more subjective health complaints ($P = 0.024$), more psychological complaints ($P = 0.030$), and a greater number of body parts experiencing pain and injury (0.025). **Conclusions:** FA pain and injury in elite adult Irish dancers is commonplace and comparable to levels of injury in other elite forms of dance. A complex mix of biopsychosocial factors moderate FA pain and injury in this cohort.

SEM 124 To investigate the effect of a 6-week combined resistance and endurance exercise programme, on dynamic balance and flexibility, in chronically ill older adults

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Introduction: To investigate the effect in which a 6-week combined resistance and endurance exercise class has on dynamic balance and flexibility in chronically ill elderly individuals. Study Design: Pre-test post-test design Setting: MedEx Medical Chronic Illness Rehabilitation Centre in DCU. **Methods:** Ten chronically ill older adults (males=7, females=3; mean age 66±7.1 years; condition cardiovascular disease=5, chronic obstruction pulmonary disease=3, peripheral artery disease= 2) volunteered to take part in the study. Participants were required to attend DCU on two separate occasions, 6 weeks apart, in order to get pre and post-intervention scores. Participants were asked to attend a group exercise class for a minimum of once per week, but preferably twice per week. Dynamic balance was measured using the Star Excursion Balance Test (SEBT) and flexibility was measured using the Sit and Reach test. Data Collection and Analysis: All SEBT measures were normalized to leg length. Paired-samples T-Tests were run on composite balance scores, individual balance directions and for Sit and Reach scores pre and post intervention. **Results:** Composite balance scores significantly improved on dominant ($P=0.004$) and non-dominant legs ($P=0.025$). Significant improvements were noted in the posteromedial direction ($P=0.034$) for the dominant leg and in the posterolateral direction ($P=0.039$) for the non-dominant legs. No significant differences were noted in the other 2 directions on either foot. Improvements noted in the Sit and Reach test were not significant ($P= 0.054$). **Conclusion:** Dynamic balance significant improves after a 6-week group exercise intervention. This is primarily due to significant improvements in individual directions. Six weeks of this combined exercise program is an insufficient time frame for flexibility to significantly improve in chronically ill older adults.

ITR 126 The evaluation of hip adduction strength, hip abduction strength, and adductor:abductor strength ratio in elite gaelic footballers with previous hip or groin injury.

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Introduction: It has been previously identified that strength imbalances of the hip adductor and abductor musculature is an intrinsic risk factor for groin strain in athletes which may lead to long term pathologies. The synergistic action of the hip adductor and abductor musculature stabilizes the pelvis on the stance leg whilst performing single leg activities, and hence is important during athletic manoeuvres such as cutting and high velocity changes of direction. Despite the prevalence of hip and groin injuries in Gaelic football there has been very little research on the topic to date. Purpose: To determine if athletes with previous hip or groin injuries exhibited subsequent strength imbalances in the hip abductor and adductor muscles. **Methods:** 45 elite Gaelic football players (Mean age = 19.0 years ± 2.6) were included in a single test trial. Maximal isometric voluntary contractions for hip abduction and hip adduction were recorded using hand-held dynamometry with external belt-fixation. A subsequent adductor-to-abductor strength ratio was calculated and factorial ANOVA was used to determine differences in scores of athletes with previous hip or groin injuries or pain. **Results:** No significant differences were found between athletes with previous hip or groin injury and matched controls in terms of maximal hip adduction strength, maximal hip abduction strength, or altered adductor:abductor strength ratio. **Conclusion:** Previous history of groin or hip injury does not influence subsequent adductor strength or abductor strength, nor does it alter their strength ratio. More research into the mechanisms of previous groin injury resulting in subsequent long-standing groin pain or re-injury must be carried out to find the most effective ways of preventing it from happening.

TOR 127 An audit of an interdisciplinary sports injury and musculoskeletal clinic in a public health setting, 2013-2014

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Introduction: The Cappagh National Orthopaedic Hospital (CNOH), musculoskeletal clinic established in 2004 is a collaboration between a Sports Medicine Physician, Orthopaedics, Physiotherapy and Diagnostic / Interventional Radiology and aims to provide a timely and seamless patient journey for sports related pathology from referral, assessment and diagnosis to treatment. This study audited the activity of this clinic over a 1-year period (2013-2014) **Methods:** Data was prospectively collected on number of referrals, referral sources, types of conditions, investigations ordered and management decisions. Results were analysed using

descriptive statistics. **Results:** 397 clinic appointments (180 new, 217 review) were provided. Gender ratio was 2:1 in favour of men (66%). The most common referral source was the general practitioner (n= 254; 63.9%), followed by sports medicine physician, (n=122; 30.7%). The mean waiting time for an initial appointment was 23 days. Knee conditions (n=107; 27%) were most common, followed by hips (n= 58, 14.4%), shoulders (n=44; 11%), spinal (n=41, 10.3%), foot/ankle (n=27; 6.8%) and pelvic (n=25; 6.3%). MRI (n=115) and X-ray (n=27) were the most common images requested. 36 patients received injection therapy at clinic and 13 were referred on for diagnostic or image-guided therapeutic injections. 50.5% of patients required onward referral to physiotherapy (n=49), orthopaedics (n=35) or general surgery (n=11) with 49.5% discharged directly from the clinic following diagnosis and management planning. **Discussion:** This audit reviews a unique interdisciplinary sport clinic over a 1-year period. It provides timely access for patients with mean waiting time of 23 days. The multidisciplinary approach enabled a seamless patient journey and the clinic successfully managed and discharged almost half of patients without any onward referral. Further developments could include a patient satisfaction survey to evaluate the quality of service and patient experience. As the primary referral source is the GP continued communication with; and education of colleagues in Primary Care is essential.

ITR 128 What is the definitive rehabilitation protocol for returning to sport confidently after a hamstring strain? An evidence-based review

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Introduction: Hamstrings are consistently regarded as one of the most common injuries occurring in sport. Furthermore they have a worryingly high recurrence rate for both athletes and the clinician attempting to rehabilitate them. Great efforts must be made to ensure that rehabilitation protocols implemented after sustaining a hamstring strain are optimal. **Purpose:** To systematically analyse the current literature pertaining to the rehabilitation of hamstring strains and their injury prevention interventions in order to conclude what are the best strategies to include in the design of a thorough rehabilitation protocol. **Methods:** Articles were searched for in google scholar, PubMed, and science direct under the terms “hamstring strain” in conjunction with “rehabilitation” or “injury prevention”. Only Randomized Controlled Trials (RCT) were selected to be reviewed in relation to rehabilitation, cohort intervention studies were also included for the injury prevention analysis. **Results:** Four RCTs pertaining to rehabilitation protocols and four RCTs and six cohort intervention studies related to injury prevention interventions were obtained for review. **Conclusion:** From the literature it is clear that a multi-modal rehabilitation protocol must be put in place for both first-time and recurrent hamstring strains. Efforts should be made to incorporate lengthened eccentric strengthening, trunk stabilization, and agility protocols. At end stage rehabilitation the programme should be tailored to the athlete’s sport addressing possible aspects of the sport which may render athletes susceptible to hamstring strain.

SEM 129 Post-activation potentiation phenomenon in male rugby players

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Introduction: Rugby is a field sport where athletes perform repeated multi-directional muscle efforts such as sprinting, jumping, scrumming and cutting. Previous research has shown that muscle power can be transiently enhanced following heavy resistance exercise via a post-activation potentiation (PAP) effect. Complex training aims to utilise this PAP effect to improve a player’s performance in game scenarios requiring high efforts of muscle power. **Methods:** This current study enlisted male (n=10), resistance trained (> 5 yr), rugby players (mean±SD; age 19±1 yr; height 1.79±0.06 m; mass 95±12 kg; body fat 15±4%) with a strength to mass ratio for a 3-RM back squat of 1.8±0.3 kg.kg⁻¹ BM. Following medical screening and familiarisation, volunteers performed a 3-RM back squat assessment, inclusion criteria stipulated that 3-RM load >1.5 kg.kg⁻¹ BM. Testing was performed on four separate occasions, with a minimum of 7 days between successive tests. Following a dynamic warm-up, participants completed a body mass squatting protocol followed by a performance test at 0, 3, 6, 9, 12 and 15 min. Following a 30 min seated rest, participants completed identical testing procedures, however, the squatting protocol was loaded to equate to each individual’s 3-RM capacity. Performance tests were randomised per testing session and included an Illinois speed agility test, a counter-movement jump, the soccer T test and analysis of contractile characteristics of the dominant rectus femoris musculature using a linear displacement transducer following application of a 0.2 ms stimulating pulse (400mA at 400V). Effects of PAP on performance tests will be discussed.

SEM 130 Sedentary patterns and their impact in peripheral arterial disease

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Introduction: The ambulatory limitation associated with peripheral arterial disease (PAD) reduces daily physical activity (PA), placing individuals with PAD at the extreme low end of the activity spectrum. Excessive sedentary behaviour may have deleterious cardiometabolic effects, independent of PA levels. In addition, the pattern in which sedentary time is accumulated is clinically significant. Breaking up sedentary time can have a beneficial effect on metabolic biomarkers, independent of total sedentary time. To date no study has directly and objectively measured sedentary behaviour in individuals with PAD. **Methods:** Men (n=18) and women (n=4), 69.0 ± 8.4 yr, with documented PAD [mean ankle brachial index (ABI) 0.73 ± 0.18] wore an ActivPAL3™ motion sensor continuously for 7 d. Resting and post-exercise ABI was measured. Walking capacity was assessed using an incremental treadmill test and a corridor-based 6 min walk test. Quality of life (QoL) was determined using the Peripheral Artery Questionnaire. **Results:** Participants spent a mean of 18.9 ± 2.1 h ($79.0 \pm 9.0\%$) of the total day and $67.6 \pm 13.3\%$ of waking day sedentary. On average $35.6 \pm 17.8\%$ of the total daily sedentary time were spent in bouts >60 min in duration. Prolonged sedentary bouts were significantly related with cardiometabolic risk markers; DBP ($r=0.57$), CRP ($r=0.44$), and total cholesterol ($r=0.45$). Post-exercise change in ankle SBP was inversely related with total sedentary time ($r=0.49$, $P<0.05$) and the no. of sedentary bouts >60 min ($r=0.47$, $P<0.05$), and positively related with total standing time ($r=0.46$, $P<0.05$) and the no. of sedentary bouts <5 min ($r=0.60$, $P<0.01$). QoL was related to total sedentary time ($r=-0.54$, $P<0.01$). **Conclusion:** Excessive and prolonged sedentary behaviour is associated with cardiometabolic health, disease severity and QoL in PAD.

SCI 132 Effect of interval and endurance training on anthropometric, physiological, metabolic and performance indices in club level gaelic football players

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Introduction: Gaelic football is a field-based sport characterised by irregular changes of pace and anaerobic effort interspersed with periods of light to moderate aerobic activity. High volume endurance training (HVET) has traditionally been used to improve aerobic capacity in club level Gaelic football players. While ideal for developing aerobic capacity, this type of training is extremely time consuming. In contrast, 2 to 4 weeks of low volume short duration high intensity interval training (LS-HIT) has been shown to improve VO_{2max} to a similar extent as HVET in college age students. **Methods:** Club level male Gaelic football players were randomly assigned to a LS-HIT (n=7; 21.6 ± 2.1 yr) or a HVET (n=8; 21.9 ± 3.5 yr) group. Participants trained 3 d.week⁻¹ for 2 weeks. Maximal aerobic capacity (VO_{2max}), running economy (RE), blood lactate levels and time trial (TT) performance were measured at baseline and after 2 weeks. **Results:** VO_{2max} and TT performance increased significantly in both the LS-HIT (7.2% & 32%) and HVET (5.4% & 21.1%) group in response to the 2 week training program. There was no change in RE or lactate threshold (LT) in either group after training. Running velocity at 4 mmol.L⁻¹ increased ($P<0.05$) in the HVET group and decreased ($P<0.05$) in the LS-HIT group after training. Blood lactate levels were higher ($P<0.01$) after each training session in LS-HIT than HVET. **Conclusion:** The total training time and total exercise time (exercise only) was 92% and 66% lower in LS-HIT than HVET. LS-HIT is a time efficient training method for improving aerobic capacity and time trial performance, and maintaining indices of running economy and lactate threshold in Gaelic football players.

SEM 135 Use of inertial sensors and depth cameras to classify performance using functional screening tools

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Introduction: Athletic screening is an important component of injury prevention and rehabilitation. However, screening can prove time consuming and the data collected is often unreliable. This leads to inefficient time management and poor decision-making. Recent developments in Inertial Measurement Units (IMUs) and Red Green Blue Depth (RGBD) cameras may allow for automated screening tools that can produce valid and reliable data. Hypothesis: It is expected that by using sensor fusion techniques, inertial and RGBD sensor technologies will provide a comprehensive biomechanical analysis of human movement. These can then be adapted to aid the collection of data using common screening tools. **Methods:** Initially a suitability study involving 20 strength and conditioning trained participants is being conducted to ascertain whether IMUs and RGBD cameras can be used to classify simple biomechanical movements. The initial exercises to be investigated are half squat, lunge, single leg squat, deadlift and tuck jump. Data will be analysed in order to extract common features to allow

recognition and evaluation of these exercises. Sensor fusion techniques will be investigated to see if they can maximise the accuracy of movement analysis. **Results:** Preliminary data analysis shows promising results in movement analysis. It is anticipated that the sensors will be able to distinguish and grade common deviations in the exercises. **Conclusion:** It is hoped that this work will allow for the development of automated screening tools to detect potential deficiencies in form and enable low cost biomechanical analysis for screening and rehabilitation purposes.

SCI 136 Comparison between different dynamic warm-up protocols on anaerobic exercise performance in male athletes.

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Introduction: Usage of a dynamic warm-up (DWU) has replaced static stretching as the warm-up of choice for many athletes. Recent research has investigated usage of a weighted dynamic warm-up (WDWU) as a means of enhancing performance. The aim of this study was to compare a DWU with a WDWU using a weighted vest equivalent to 10% of an individual's body mass and its effect on anaerobic performance. **Methods:** Fifteen (n=15) athletes completed a repeated measures randomised controlled study. Following familiarisation, each participant returned for testing on four separate occasions to investigate a single outcome measure during each visit. The outcome measures investigated were vertical jump (VJ), standing long jump (LJ), 20m sprint time and a modified Illinois speed agility test. Data were analysed using a repeated measures ANOVA with Tukey post-hoc analysis completed as required. **Results:** Improvements in VJ, LJ and 20m sprint performance were detected ($P < 0.05$) following both warm-up conditions when compared to baseline. No significant differences were identified in the modified Illinois speed agility test data following either warm-up when compared to baseline. No significant differences were detected between DWU and WDWU in any of the outcome measures assessed. **Conclusion:** A DWU can enhance an athlete's VJ, LJ and 20m sprint times but does not result in improved speed agility performance. The addition of a weighted vest, equivalent to 10% of body mass, does not result in improvements in anaerobic exercise performance when compared to a non-weighted DWU.

SEM 137 An assessment of the effect of an exercise intervention on quality of life and cancer related fatigue in advanced cancer patients

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Introduction: Quality of life (QoL) is a multidimensional concept incorporating physical, mental and social components. QoL in advanced cancer patients is generally lowered due to side effects and symptoms associated with cancer and its treatments. Cancer related fatigue was a primary symptom of investigating in this research. Exercise is an under-utilised and under-researched intervention which may improve the QoL of the advanced cancer population on a number of levels. A structured and supervised exercise intervention was conducted for 6 weeks for a group of advanced cancer participants. Baseline testing was carried out on all participants prior to the intervention and the same testing procedures were repeated after the 6 week intervention. The aim of this research was to investigate the effects of an exercise intervention on the global QoL and fatigue levels advanced cancer participants. **Methods:** Quantitative and qualitative methods were used. A total of 7 participants completed the intervention. The supervised exercise classes, involving aerobic and strength elements, took place twice a week in the DCU sports complex. Quantitative measures included global strength, aerobic fitness, flexibility, quality of life and fatigue. Qualitative assessment of attitudes towards the exercise intervention was conducted via 2 focus groups, pre and post intervention. Results were recorded from all participants and analysed using the SPSS software. **Results:** Statistically significant improvements were found in the measures of fatigue (using the FACIT-F), global QoL (using the SF-36) and global strength (using the timed sit to stand test). Body composition, flexibility and aerobic fitness did not change significantly. **Conclusion:** Given the positive results that were produced from this research, exercise should be further evaluated as a treatment option for improving the global QoL of advanced cancer patients.

SCI 145 The relationship between workload at functional threshold power and maximal lactate steady state in male amateur triathletes

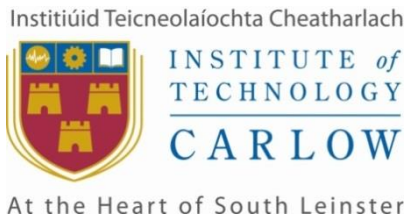
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Introduction: Functional threshold power (FTP), when cycling, is purported to be the maximum power output that can be maintained for a one hour effort. FTP is typically computed by assessing mean power output over 8 or 20 min maximal time-trial efforts, namely 90 and 95% of mean power, respectively. This measurement resembles the more traditional physiological measurement of maximum lactate steady state (MLSS). MLSS is defined as the highest blood lactate concentration (MLSSc) and associated work load (MLSSw) that can be maintained over 30 min without a continuous increase in blood lactate accumulation, maximal rate of increase in $BLa < 0.05 \text{ mmol.L}^{-1} \cdot \text{min}^{-1}$ from 10 to 30 min. The current study assessed the equivalence, if any, between FTP and MLSSw. **Methods:** Assessments, performed on male triathletes (n=11), included quantification of lactate threshold using a graded incremental test, quantification of FTP using 8 and 20 min maximal time-trial efforts and a 30 min steady-state test at the computed FTP based on 8 min time-trial to compute lactate kinetics. To date, 5 volunteers have completed all 4 test elements. **Results:** An interim results analysis revealed that performing a 30 min steady-state test at computed FTP over-estimated MMLSw; all volunteers exhibited non steady-state lactate ($BLa/t > 0.05 \text{ mmol.L}^{-1} \cdot \text{min}^{-1}$) kinetics. In addition, FTP based on the 8 min time-trial ranged from 12 to 21% higher than FTP based on the 20 min time-trial. **Conclusion:** caution should be advised when using FTP as a quantifier of exercise capacity or as a longitudinal monitor of training induced improvements in amateur triathletes.

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