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Abstract #1

The Relationship Between Adductor-Abductor Strength Imbalance and Performance of a Functional Hop in Elite Gaelic Football Players

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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. 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 (19.2 ± 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 ($r = 0.213$, $P = .297$) was observed between adduction-abduction strength ratio and triple hop for distance.

Conclusions: From our study it can be seen that the triple hop for distance is not a good indicator for hip adductor-abductor strength imbalances. Furthermore, research should focus on other functional tests, which could possibly identify those who are susceptible to adductor injuries.

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Abstract #2

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 maneuver. 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 ± 44.04 cm, weight = 78.57 ± 22.44 kg) collegiate athletes volunteered. Participants performed the LRH test bilaterally during 2 testing sessions separated by $\sim 3 \pm 1$ hours. Reliability data were analyzed through repeated-measures analysis testing.

Results: Analysis demonstrated an ICC value of 0.72 (95% CI = 0.41–0.87) and an SEM value of 5.23% for the LRH test. There was no statistically significant difference ($P = .95$) in scores between session 1 ($94.97\% \pm 5.70$) and session 2 ($95.03\% \pm 5.50$).

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.

Abstract #3

The Effect of Fatigue on King-Devick Scores in Female Athletes

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Background: 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 3 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. The aim of this study was to establish if fatigue influenced KD scores in nonconcussed athletes using a repeated measures design.

Methods: Thirty-six sports women (23 footballers, 13 lacrosse players) (age = 21 ± 4 years) participated. Each completed the KD test before and after a training session. The data were analysed using paired t-tests and a proportion difference test.

Results: All subjects reached 15 or higher on the Borg scale. KD baseline scores were 41.2 ± 7.2 and 40.7 ± 6.8 seconds postexercise. The mean difference was 0.51 seconds (95% CI –1.07 to 2.01, $t = -0.653$, $P = .518$). The majority of the participants recorded faster fatigue scores than at baseline (22/36, 0.61, 95% CI 0.45 to 0.75, $Z = 1.33$, $P = .18$).

Conclusions: 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-second increase stipulated for further concussion investigation.

Abstract #4

Neck Pain in a 24-Year-Old Male Professional Arena Football Athlete

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Background: A 24-year-old professional arena football defensive back presented complaining of burning and tingling in both arms after a collision during a game. The athlete had a previous history of chronic bilateral brachial plexus neuropraxia. 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 where radiographs were requested.

Differential Diagnosis: Chronic bilateral brachial plexus neuropraxia, cervical fracture, disc herniation, spinal lesion.

Treatment: Radiographs revealed normal cervical vertebral alignment, normal marrow, a 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, and 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. Physical therapy included exercises to increase neck and shoulder range of motion and strength.

Uniqueness: Facet disease or disc degeneration is rarely diagnosed in a youthful population; however, this patient has undergone enough cervical traumas to induce early onset facet and disc degeneration.

Conclusions: Repetitive trauma from chronic burners and the excess stress placed on the cervical spine, more specifically the facet joints, caused the degeneration. This finding reiterates the importance of early recognition, management, and prevention of chronic brachial neuropraxias in football players.

Abstract #5

The Inter-Tester and Intra-Tester Reliability of an Electronic Inclinometer Application in the Measurement of Hip Range of Motion and Muscle Length in Elite Gaelic Footballers: A Preliminary Report

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Background: 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 2 people. The aim of this study was to determine intra-tester and inter-tester reliability of an electronic inclinometer in determining hip joint ROM and muscle length in elite Gaelic footballers.

Methods: Seventeen 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 retest session carried out 3 hours later. Intra-class correlation coefficients (ICC) were used to assess reliability. For this study, an ICC greater than 0.75 was considered excellent, from 0.4 to 0.75 was considered fair to good, and less than 0.4 was considered poor.

Results: Excellent 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 = .963) ($P < .001$). The intra-tester reliability was also excellent with ICC values for the 3 testers ranging from .956–.975 for the active knee extension, .818–.887 for the Thomas test, .825–.842 for internal rotation, and .900–.939 for external rotation ($P < .001$).

Conclusions: The results of this study demonstrate excellent reliability. Therefore, an electronic inclinometer application is a reliable clinical measure of hip ROM and lower limb muscle length in elite Gaelic footballers.

Abstract #6

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. This study aims to examine the effectiveness of selected FM tools on removal time and efficacy of the QR side clips after 1 season of NCAA Division II Football.

Methods: A total of 82 American football helmets and 164 QR side clips were tested to determine time of face-mask removal and success rate using 3

tools: (1) QR Insertion Tool [IT], (2) FMextractor [FM], and (3) Ballpoint Pen [BP]. Success trials were defined as the ability to remove both QR side clips in less than 2 minutes.

Results: Overall success rate of QR side clip removal was 92.7% (152/164) with results varying by tool (IT = 100%, FM = 80.2%, BP = 96.4%). The 76 successful trials (<2 minutes) were further analysed using a 1-way ANOVA. Results revealed no significant differences in mean QR side clip removal time between the 3 tools ($F_{2,73} = 2.493, P = .90$). Removal times of 21.2 sec (IT), 18.20 sec (FM), and 11.40 sec (BP) were recorded.

Conclusions: The results of this study are consistent with earlier investigations that suggested a 6%–8% failure rate should be expected when attempting to remove faceguards. 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.

Abstract #7

Tailored Movement Control Retraining in a Female Elite Rower With Persistent Femoroacetabular Impingement Symptoms: A Case Report

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Introduction: Movement control retraining on a 26-year-old female elite rower with symptomatic left femoroacetabular impingement, 4 years post-arthroscopic surgery. Previous physiotherapy (general exercise and stretching) did not lead to any long term changes.

Treatment: A tailored 16 week movement control retraining programme for uncontrolled movements (UCMs), identified using The Foundation Matrix (The Performance Matrix), was developed for this athlete. The programme consisted of low-threshold motor control recruitment training twice a day, and high-threshold strength and speed retraining up to 4 times/week. Outcome measurements recorded were the HAGOS (hip and groin outcome score), The Foundation Matrix score, passive/active left hip ROM (range of motion) workload (training time on water), and pelvic kinematics (seated left hip flexion task). Evaluation pre-intervention (pre) and 16 weeks later following training intervention (post) found the following changes. An increase in score for all 6 subscales of HAGOS: symptoms (61/100 pre, 96/100 post); pain (53/100 pre, 93/100 post); physical function (65/100 pre, 100/100 post); sport (56/100 pre, 100/100 post); physical activities (13/100 pre, 75/100 post); quality of life (32/100 pre, 85/100 post). The Foundation Matrix score improved (25/50 to 9/50 UCM impairments, percentage improvement of UCMs at low threshold from 53% to 21% and high threshold 50% to 28%). Hip flexion ROM improved passively (pre 78°, post 116°) and actively (98° to 118°). Workload increased from 4 to 18 hours a week. Kinematic analysis showed reduced posterior tilt, upward rotation, and external rotation of the pelvis postintervention by 4.5°, 2°, and 3.9°, respectively.

Uniqueness: Targeted movement control retraining is a novel approach to address long-standing femoroacetabular impingement symptoms.

Conclusions: A 16-week programme improved symptoms, function and changed pelvic kinematics in an elite female rower with long-standing femoroacetabular impingement symptoms. This approach may be useful in managing other athletes with such symptoms.

Abstract #8

Epidemiology of Injury in the Hip/Groin/Thigh Region in Adolescent and Collegiate Gaelic Footballers and Hurlers

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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 ($n = 292, 15.7 \pm 0.8$ years) and collegiate ($n = 342, 19.4 \pm 1.9$ years) Gaelic footballers and hurlers took part in a 1-year prospective epidemiological study. Any injury sustained during training or competition resulting in restricted performance or time lost from play was assessed weekly by an athletic rehabilitation therapist. An injury report form was completed to ensure standardisation of the injury description.

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. Noncontact 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.

Abstract #9

Hip and Shoulder Rotational Range of Motion in Youth Baseball Pitchers

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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; specifically, the upper extremity. The objective of this study was 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 years; 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 using a digital inclinometer. Hip PROM was measured seated, with knees flexed to 90° . While shoulder PROM was performed with the arm in 90° of abduction in the coronal plane.

Results: No significant side-to-side differences were observed for the hip variables ($P > .05$). Shoulder external rotation (ER) ($110.5^\circ \pm 11.4^\circ$) was significantly greater than shoulder internal rotation (IR) ($34.5^\circ \pm 15.4^\circ$). The lead leg hip had significantly greater ER ($37.2^\circ \pm 6.6^\circ$) than IR ($28.4^\circ \pm 6.1^\circ$). Shoulder ER revealed significant correlations with both lead ($r^2 = 0.20$, $P = .02$) and stance hip IR ($r^2 = 0.23$, $P = .01$).

Conclusions: Youth baseball pitchers display similar ROM of patterns compared to collegiate and professional counterparts. The present study reveals that the ROM patterns displayed by these youth may indicate ROM patterns survive maturation. It is therefore suggested that clinical focus be directed to maintaining hip and shoulder rotational ROM throughout maturation. As the literature has reported, there are relationships between hip ROM and pitching mechanics; therefore, with the present study displaying a relationship between shoulder and hip PROM, it is imperative that future work be directed to further examining hip and shoulder PROM in relation to not only injury prevention but also pitching performance.

Abstract #10

Anterior Capsule Strain of the Hip in a Team Handball Goalkeeper: A Case Study

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Background: A 28-year-old female, team handball goalkeeper presented with increased left anterior hip pain when weight bearing and sitting with the hip flexed at 90° . The mechanism of injury was unknown. The patient was unable to perform squatting or lateral movements while playing team handball. Orthopedic examination 2 days following onset of pain revealed a labral tear.

Differential Diagnosis: Anterior capsule strain.

Treatment: A MRI arthrogram 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. Prior to rehabilitation, affected side internal rotation measured 27° and external rotation was 35° , whereas unaffected internal rotation was 34° and external rotation was 27° . 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.

Uniqueness: Hip injuries are not commonly reported in 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.

Conclusions: An increased emphasis on strengthening the entire LPHC may be warranted for team handball goalkeepers in order to better stabilize the hip joint.

Abstract #11

Examining the Test-Retest Reliability of the Multiple Single-Leg Hop-Stabilization 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 clinical examination; however, there is no gold standard measure. The multiple single-leg hop-stabilisation test (MSLHST) is a functional test comprised of static and dynamic components, whereby athletes jump to and from 10 marks, maintaining balance for 5 seconds after landing. It may offer a way of assessing athletic balance, but to be used clinically and in research for longitudinal monitoring it needs to show adequate test-retest reliability. This study examined test-retest reliability and investigated possible performance indicators.

Methods: Fifteen healthy, active participants were recruited from university staff, students, and local athletes (age = 32.8 ± 9.2 years, height = 174.2 ± 9.5 cm, weight = 71.4 ± 7.5 kg). Testing was undertaken in a university movement laboratory. Participants were tested twice with a 10-minute break between tests. Outcome measures were the MSLHST score on the dominant and nondominant legs. Results were analysed using an intraclass correlation coefficient (ICC 2,1) and Bland-Altman plots. Regression analysis explored the relationship between MSLHST scores and the effects of age and training. Analyses were performed with $\alpha = 0.05$.

Results: ICCs were .85 (dominant leg) and .85 (nondominant leg). Confidence intervals ranged from .62–.95 and .61–.95 for dominant and nondominant legs, respectively. Bland-Altman plots showed all scores were within 2 standard deviations. A significant correlation was observed between the dominant and nondominant leg on balance scores ($R^2 = .49$, $P < .05$), and that better balance was associated with younger participants (nondominant leg: $R^2 = .28$, $P < .05$; dominant leg: $R^2 = .39$, $P < .05$) and a higher number of hours spent per week engaged in sporting activity (nondominant leg: $R^2 = .37$, $P < .05$).

Conclusions: Using healthy active participants, the MSLHST was found to be a reliable clinical measure of balance. Younger participants who trained more have better balance scores. Future research may address the validity of the MSLHST.

Abstract #12

The Effect of a 6-Week Balance Training Program on Postural Stability

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Introduction: Dynamic postural stability is an integral component of athletic function, with previously published literature indicating that decreased postural stability is an intrinsic risk factor for lower limb athletic injuries. This study aims to determine whether a 6-week balance training program would improve postural stability.

Methods: A convenience sample of 49 collegiate athletes (27 females, 22 males) participated in the study (age = 19.98 ± 1.39 years, height = 181.48 ± 12.79 cm, mass = 384.96 ± 84.11 kg). 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 baseline testing, the intervention group completed a 6-week balance training program which consisted of static and dynamic single-leg stance exercises with eyes open and closed. Each exercise was performed for 30 seconds.

Results: In the control group, there was no significant change in postural stability composite score from baseline to postintervention (2.5 ± 0.5 and 2.4 ± 0.4 , respectively; $P < .4$; mean change = -0.06 95% CI = -1.0 , 0.9). 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; $P < .007$ and $P < .002$; Mean change = 0.39 and 0.18 ; 95% CI = -0.29 , 0.65 and -0.43 , 1.21). Postintervention, no significant differences in composite scores were found between genders. There was a significant change in the intervention group composite scores from postintervention to 2 weeks postintervention ($P < .001$). Postural stability significantly improved from postintervention to 4 weeks postintervention ($P < .001$). However, stability did not change significantly between 2 and 4 weeks postintervention.

Conclusions: Postural stability was significantly improved with 6 weeks of postural stability training in both male and female basketball players. Postural stability changes observed after the completion of the intervention indicate a latency effect.