Abstracts - Oral Presentation (Original Research)

Back to TOP

Time	Session 1: Sports Rehabilitation	Speaker
09:00 - 09:15	Controlled Trial to Compare the Achilles Tendon Load during Running in Flatfeet Participants Using a Customized Arch Support Orthoses vs an Orthotic Heel Lift	Mr. Kawin KW LEE (ORT, CUHK)
09:15 - 09:30	Prognosis of Elite Basketball Players After an Achilles Tendon Rupture	Ms. Naomi FUNG / Mr. Ronald SIU (ORT, CUHK)
09:30 - 09:45	Effect of Aquatic Exercise of Sleep Efficiency on Adults with Chronic Musculoskeletal Pain	Ms. Ka Man YEUNG (RS, PolyU)
09:45 - 10:00	Altered Quadriceps Muscle Stiffness is Associated with Poor Knee Function and Quadriceps Performance after Anterior Cruciate Ligament Reconstruction	Ms. Xin HE (ORT, CUHK)
Time	**Session 2: Sports Medicine**	**Speaker**
11:45 - 12:00	Effectiveness of Tai Chi to Alleviate Metabolic Syndrome in Centrally Obese Older Adults: A Randomized Controlled Trial	Mr. Angus, Pak Hung YU (SPH, HKU)
12:00 - 12:15	Development of an All-Suture Anchor for a Rat Rotator Cuff Tear Model	Mr. Yang LIU (ORT, CUHK)
12:15 - 12:30	The Effects of Shoe Collar Height on Ankle Sprain Prevention: A Systematic Review	Ms. Jojo HC LAI (ORT, CUHK)
12:30 - 12:45	Are Running Biomechanics the Cause of High Injury Risk in Trail Runners?	Ms. Sin Ming LI (ORT, CUHK)
12:45 - 13:00	High Glucose Environment Can be a Cause to Tendinopathy via Exaggerated Inflammation and Weakened Pro-Resolving Response	Mr. Cheuk Kin KWAN (ORT, CUHK)
Time	**Session 3: Exercise Science**	**Speaker**
14:15 - 14:30	Footstrike Pattern Classification of Using Footstrike Angle in Experienced, Novice and Non-runners	Mr. Shiwei MO (RS, PolyU)
14:30 - 14:45	Effectiveness of an In-Field Running Retraining Using a Footstrike Pattern Feedback System	Ms. Zoe Yau-Shan CHAN (RS, PolyU)
14:45 - 15:00	Effects of Pose® Method Gait Retraining on Running Biomechanics in Distance Runners	Ms. Rachel WEI (ORT, CUHK)
15:00 - 15:15	Time Required to Familiarize a Novel Footwear Condition for Treadmill Running Test	Mr. Peter Pak-Kwan CHAN (RS, PolyU)
15:15 - 15:30	Cross-sectional Study of Surface Electromyography Activities on Shoulder Muscles of Elite Lifesaving Athletes	Mr. Hon Ting TSE (RS, PolyU)
Time	**Session 4: Exercise Science**	**Speaker**
16:00-16:15	A mHealth Intervention on Patients' Post-Surgery Rehabilitation Adherence: Test of Self-Determination Theory	Mr. Alfred Sing Yeung LEE (SPH, HKU)
16:15-16:30	Evaluation of Mindfulness-Based Intervention on Enhancing Shooting Performance in Elite Air Pistol Shooters	Ms. Ka Kay LO (HS, EDUHK)
16:30-16:45	The Influence of Psychological Factors in Patients with Rotator Cuff Tendinopathy: A Systematic Review	Mr. WAI KEUNG WONG (ORT, CUHK)
16:45-17:00	Identification of Senior Primary School Students with Potential Mood Problems Using Video-Based Gait Analysis	Mr. Alan Kwong Yik LOK (RS, PolyU)
17:00-17:15	The Effect of Brief Mindfulness Intervention as Adjuvant of Fluid Intake to Refuel Soccer Players during Half-time Break	Mr. Yuxin ZHU (HPE, EDUHK)

Oral Presentation (Original Research)

Session 1: Sports Rehabilitation

Controlled Trial to Compare the Achilles Tendon Load during Running in Flatfeet Participants Using a Customized Arch Support Orthoses vs an Orthotic Heel Lift

Kawin KW Lee[1], *Samuel KK Ling*[2], *Patrick SH Yung*[2]
[1] Department of Prosthetics and Orthotics, Queen Mary Hospital, Hong Kong
[2] Department of Orthopaedics and Traumatology, Faculty of Medicine, CUHK

Background: Achilles tendinopathy is one of the most common overuse injuries in running, and forefoot pronation, seen in flatfeet participants, has been proposed to cause additional loading across the Achilles tendon. Foot orthoses are one of the common and effective conservative treatment prescribed for Achilles tendinopathy, it works by correcting the biomechanical malalignment and reducing tendon load. Previous studies have shown reduction of Achilles Tendon load (ATL) during running by using customized arch support orthosis (CASO) or an orthotic heel lift (HL). However, there are still little biomechanical evidence and comparative studies to guide orthotic prescriptions for Achilles tendinopathy management. Therefore, this study seeks to investigate the two currently employed orthotic treatment options for Achilles tendinopathy: CASO and HL for the reduction of ATL and Achilles tendon loading rate (ATLR) in recreational runners with flatfeet.

Methods: 12 participants were recruited and run along the runway in the laboratory for three conditions: (1) without orthoses, (2) with CASO (3) with HL. Kinematic and kinetic data were recorded by 3D motion capturing system and force platform. Ankle joint moments and ATL were computed and compared within the three conditions.

Results: Participants who ran with CASO ($p=0.001$, $d=0.43$) or HL ($p=0.001$, $d=0.48$) associated with a significant reduction in ATL when compared to without orthotics while there was no significant difference between the two types of orthoses, the mean peak ATL of CASO was slightly lower than HL. Regarding the ATLR, both orthoses, CASO ($p=0.003$, $d= 0.93$) and HL ($p=0.004$, $d= 0.78$), exhibited significant lower value than the control but similarly, no significant difference was noted between them in which the use of CASO yielded a slightly lower loading rate than that of HL.

Conclusions: Both CASO and HL were able to cause a significant reduction in peak ATL and ATLR comparing to without orthotics condition. There were subtle but no statistically significant differences in the biomechanical effects between the two types of orthoses. The findings help to quantify the effect of CASO and HL on load reduction of Achilles tendon and suggests that foot orthoses may serve to prevent the incidence of Achilles tendon pathologies.

Trial registration: NCT04003870 on clinicaltrials.gov 1 July 2019

KEYWORDS: Achilles tendon, tendinopathy, flatfeet, runners, orthoses, arch support, heel lift, insole, Load

Prognosis of Elite Basketball Players After an Achilles Tendom Rupture

Naomi Fung, *Ronald Siu*, *Nigel Pak*
[1]Dr Samuel Ling (CUHK O&T Sports Medicine, Prince of Wales Hospital);
[2]Department of Orthopaedics & Traumatology, The Chinese University of Hong Kong

Objective: Professional Basketball players are at high risk of Achilles tendon rupture (ATR) injury. Despite this, there remains little research into the factors affecting rehabilitation and the long term outcomes of these players. Our aim is to quantify the effect of a player's Achilles tendon rupture on their post-injury performance, and also to explore for correlations between their recovery timeline and pre-injury characteristics. Creation of an injury timeline of past incidents will allow injured players to better track their progress and also inform them about the probable impact on their careers.

Hypothesis: Players with Achilles tendon rupture injury will exhibit decreased performance compared to their pre-injury self and their non-injured peers after recovery.

Methods: Data for 30 NBA players with previously sustained ATR were collected through news reports and player profile websites. Players are included for having a first time unilateral ATR between 1992 to 2016, having more than 2 years of NBA seasons played and having at least played 58 games of the regular season with an average of >/=12 minutes per game (MPG) played. Players with recurrent Achilles tendon rupture and concordant significant lower limb injuries are excluded from the study. Of the 30 players found, 12 players met our inclusion criteria. Subsequently, included players' ability to return to play (RTP) was assessed based on whether they can play 7/10 consecutive NBA games with at least an average MPG>/=12 minutes subsequent to their injury. The Player Efficiency Rating (PER) (an offical scoring system adopted by the NBA to assess a player's performance game-by-game) was collected as a means of measuring players' performance, along with variables including age, body mass index (BMI), player position and number of years played before injury. A player's performance can be observed via the widely used PER, which is a rating used to demonstrate a player's statistical contributions in all elements of the game. 1 control for each included player was selected based on their similar pre-injury PER, Age and Position. The players' index season PER was compared against the PER during the 10 games immediately following the players' return and the PER of their post injury peak performing season. The same data analysis was performed against their non-injured peers. To investigate the factors affecting the recovery and long-term consequences of their injury, we correlated the variables of Age, BMI, Time of Injury and pre-injury PER with the player's time to return to play and their post injury PER.

Results: 2 out of 12 players failed to return to playing in the NBA league following an Achilles Tendon Rupture, others returned after a mean recover time of 10.10 months. When compared to players' index PER, the mean PER reduction during the 10 games immediately following the players' return was 7.15 *(P* = .000). Players on average took 1.80 seasons to reach their post injury peak performance, with only 1 player reclaiming his pre-injury performance level. Others suffered a mean PER reduction of 3.46 (*P*= .004) when compared to their index PER and 5.42 (*P*= .045) against their matched controls.

Conclusion: Achilles tendon rupture can be a career ending injury for professional NBA players. For those who returned to play, a significant decline in performance is observed. However, the ability to retain a significant portion of one's pre-injury performance is determined by multiple factors. With appropriate rehabilitation, players may reclaim up to 80% of their pre-injury performance following an Achilles rupture.

Reference:

Amin, N. H., Old, A. B., Tabb, L. P., Garg, R., Toossi, N., & Cerynik, D. L. (2013). Performance Outcomes After Repair of Complete Achilles Tendon Ruptures in National Basketball Association Players. *The American Journal of Sports Medicine*, *41*(8), 1864–1868. doi: 10.1177/0363546513490659

Amin, N. H., Mccullough, K. C., Mills, G. L., & Jones, M. H. (2016). The Impact and Functional Outcomes of Achilles Tendon Pathology in National Basketball Association Players. *Clinical Research on Foot & Ankle*, *4*(3). doi: 10.4172/2329-910x.1000205

Arnold, K. (2018, October 24). Nine takeaways from 2018-19 NBA Roster Survey. Retrieved from https://www.nba.com/article/2018/10/24/takeaways-2018-19-nba-roster-survey.

Average NBA Career Length for Players – Details. (2012, June 25). Retrieved from https://weaksideawareness.wordpress.com/2011/11/22/average-nba-career-length-for-players-details/.

Bohman, L. (2016, December 20). A Closer Look At New Developments In Treating Achilles Tendon Ruptures. Retrieved October 12, 2019, from https://www.podiatrytoday.com/closer-look-new-developments-treating-achilles-tendon-ruptures.

Brumann, M., Baumbach, S. F., Mutschler, W., & Polzer, H. (2014). Accelerated rehabilitation following Achilles tendon repair after acute rupture – Development of an evidence-based treatment protocol. *Injury*, *45*(11), 1782–1790. doi: 10.1016/j.injury.2014.06.022

Calculate Your BMI - Standard BMI Calculator. (n.d.). Retrieved October 25, 2019, from https://www.nhlbi.nih.gov/health/educational/lose_wt/BMI/bmicalc.htm.

Calculating PER. (n.d.). Retrieved from https://www.basketball-reference.com/about/per.html.

Carroll, W. (2017, October 3). NBA's Wonderful Toys: The Technology Used in NBA Training Rooms. Retrieved from https://bleacherreport.com/articles/1857081-nbas-wonderful-toys-the-technology-used-in-nba-training-rooms.

Chauncey Billups Out With Ankle Tendinitis. (2012, December 6). Retrieved October 15, 2019, from https://www.slamonline.com/archives/chauncey-billups-out-with-ankle-tendinitis/.

Gabbett, T. (2019, August 23). Load Management is Not About Decreasing Minutes. Retrieved September 7, 2019, from https://www.physio-network.com/load-management-is-not-about-decreasing-minutes/.

Gulati, V. (2015). Management of achilles tendon injury: A current concepts systematic review. *World Journal of Orthopedics*, *6*(4), 380. doi: 10.5312/wjo.v6.i4.380

Haberstroh, T. (2019, July 1). Are we getting worse at the NBA draft? Retrieved November 6, 2019, from https://www.nbcsports.com/philadelphia/nba-insider-tom-haberstroh/are-we-getting-worse-nba-draft.

Lemme, N. J., Li, N. Y., Kleiner, J. E., Tan, S., Defroda, S. F., & Owens, B. D. (2019). Epidemiology and Video Analysis of Achilles Tendon Ruptures in the National Basketball Association. *The American Journal of Sports Medicine*, *47*(10), 2360–2366. doi: 10.1177/0363546519858609

Minhas, S. V., Kester, B. S., Larkin, K. E., & Hsu, W. K. (2016). The Effect of an Orthopaedic Surgical Procedure in the National Basketball Association. *The American Journal of Sports Medicine*, *44*(4), 1056–1061. doi: 10.1177/0363546515623028

Yang, X., & Meng, H. (2018). Management of acute Achilles tendon ruptures. *Bone Joint Res.*

Effect of Aquatic Exercise of Sleep Efficiency on Adults with Chronic Musculoskeletal Pain

Karman Ka-Man Yeung[1], *Cheuk-Ting Tam*[1], *Louis Lok Tao Li*[1], *Nathania Sing-Yan Suen*[1], *Samuela Tin-Yan Suen*[1], *Irene Hoi-Ling To*[1], *Billy Chun-Lung So*[1]
[1]Department of Rehabilitation Sciences, The Hong Kong Polytechnic University

Objective: To investigate the effect of a 6-week moderate-intensity aquatic exercise program on sleep efficiency, sleep quality, pain, stress and physical activity among adults with chronic musculoskeletal pain by series of self-reported of questionnaires and ActiGraph.

Methods: A quasi-experimental trial was conducted with a sample of 30 adults with chronic musculoskeletal pain, assigned into two groups (Intervention Group and Control Group). Subjects were recruited by convenience sampling from a community physiotherapy centre of the Tung Wah Group of Hospitals and the Hong Kong Polytechnic University. Subjects who allocated to intervention group received a structured, 6-week, bi-weekly, 60-minute aquatic exercise program. The 12 sessions were supervised by a qualified aquatic fitness instructor in a 20x10m pool with water temperature controlled. 6 exercises were performed in each session with one old exercise being replaced by a new one in each session. During the session, heart rate and RPE were constantly monitored. Control Group was reminded not to change their exercise habits or medication regimens. Outcome measures including sleep efficiency by ActiGraph, sleep quality by Chinese version of the Pittsburgh Sleep Quality Index (CPSQI), pain by numeric pain rating scale, stress by Chinese version of a Perceived Stress Scale (PSS) and activity level by Chinese version of the short form of the International Physical Activity Questionnaire (IPAQ-SF) were assessed before and after the 6-week aquatic exercise program together with the demographic data collected. Data were analyzed with version 25 of IBM's SPSS software and a p value less than 0.05 was considered as indicating statistical significance.

Results: No statistically significant differences were found on all demographic data and outcome measures between intervention and control group in the baseline measurement, except there were significantly higher average BMI ($p \leq 0.05$) and fewer total true sleep hours ($p \leq 0.001$) in intervention group. Significantly longer total true sleep time ($p \leq 0.01$), greater sleep efficiency ($p \leq 0.01$), less pain ($p \leq 0.05$) and better sleep quality ($p \leq 0.05$) were found in intervention group. Significant group-time interaction were found only in total true sleep time ($p \leq 0.001$).

Discussion and Conclusion: Aerobic exercise has been proven to be effective in improving sleep. With water's hydrostatic pressure, temperature, buoyancy and turbulence, it is suggested that aquatic aerobic exercise can improve sleep efficiency and sleep quality as well as reducing stress and pain. Although results showed only significant group-time interaction in total true sleep time, the baseline values were significantly different which made the comparison unfair. The result may not be able to directly demonstrate the effect of aquatic aerobic exercise because of baseline bias and small sample size. However, findings of this research may explain the bi-directional relationship between pain and sleep efficiency proposed by different authors before. From the within-group pre-post result, it showed that there was statistically significant improvement in terms of sleep efficiency and reduction of pain. The poorer the sleep at night, the more intense the pain in daytime or vice versa. Previous studies also reported pain levels can be used to predict sleep efficiency at night. It suggested that pain and sleep quality must have a relationship even if this study could not demonstrate due to design limitation. Further researches on this relationship with aquatic aerobic exercise should be done with larger sample size and randomization of subject to reduce the effect of baseline bias and individual differences. To conclude, there have been different prior studies investigating the effect of land-based exercise on sleep. This study helps to extend the work on the effect of aquatic-based exercise on adults with chronic

musculoskeletal pain. Although this study cannot fully demonstrate the effect of aquatic exercise, this study built a foundation for future studies.

Reference

Chen L-J, Fox K, Ku P-W, Chang Y-W. Effects of aquatic exercise on sleep in older adults with mild sleep impairment: a Randomized controlled trial. *IntJ Behav Med. 2016;23*(4):501-506.

Lee P, Suen L. The convergent validity of Actiwatch 2 and ActiGraph Link accelerometers in measuring total sleeping period, wake after sleep onset, and sleep efficiency in free-living condition. *Sleep Breath. 2017;21(1)*:209-215.

Lee P, Tse CY. Calibration of wrist-worn ActiWatch 2 and ActiGraph wGT3X for assessment of physical activity in young adults. *Gait & Posture.* 2019;68:141-149.

So BCL, Kong ISY, Lee RKL, et al. The effect of Ai Chi aquatic therapy on individuals with knee osteoarthritis: a pilot study. *J Phys Ther Sci. 2017;29*(5):884-890.

So BCL, Ng JKF, Au KCK. A 4-week community aquatic physiotherapy program with Ai Chi or Bad Ragaz Ring Method improves disability and trunk muscle endurance in adults with chronic low back pain: A pilot study. *J Back Musculoskelet Rehabil. 2019; 32*(5):755-767.

Altered Quadriceps Muscle Stiffness is Associated with Poor Knee Function and Quadriceps Performance after Anterior Cruciate Ligament Reconstruction

Xin He[1], Wanyun Huang[1], Hio Teng Leong[1], Patrick Shu-hang Yung[1]
[1]Department of Orthopaedics and Traumatology, Faculty of Medicine,
The Chinese University of Hong Kong, Hong Kong SAR, China

a) **Objectives:** This project aimed to (1) identify the alteration in quadriceps and hamstring muscle stiffness of ACLR limbs when compared with the contralateral side and healthy controls; (2) compare the difference in quadriceps and hamstring muscle stiffness between patients following ACLR with different return-to-play status; (3) investigate the association between quadriceps and hamstring muscle stiffness and self-reported knee functions as well as muscle performance.

b) **Methods:** 26 male patients with ACLR using hamstring tendon graft (13 returned to play, 13 did not) and 16 matched healthy subjects were recruited in this study. Muscle shear modulus (index of stiffness) of quadriceps and hamstring were assessed by ultrasound shear wave elastography[1] with knee and hip passively flexed at 30°. Self-reported knee functions were evaluated by IKDC and Lysholm[2,3]. Muscle performance were evaluated by isokinetic muscle strength of quadriceps and hamstring at 60°/s and 180°/s and limb symmetry index (LSI) during single leg hop test[4].

c) **Results:** The ACLR limb displayed decreased shear modulus in vasutus medialis (VM) and semitendinosus (ST) when compared with contralateral limb and healthy controls (VM: injured 3.04±0.48 kpa vs contralateral 3.27±0.48 kpa vs control 3.59±0.48 kpa, $F=6.309$, $p=0.001$; ST: injured 3.95±1.34 kpa vs contralateral 5.95±1.73 kpa vs control 6.08±1.65 kpa, $F=11.424$, $p<0.001$). Patients with ACLR who returned to play demonstrated increased shear modulus in VM when compared with those who did not (2.77±0.40 kpa vs 3.30±0.42 kpa, $p=0.003$). Decreased shear modulus of VM was associated with decreased quadriceps peak torque/body weight at 60°/s ($r=0.509$, $p=0.011$). Less symmetry in VM shear modulus was associated with greater deficit in quadriceps total work at 180°/s ($r=-0.466$, $p=0.022$) while less symmetry in retus femoris (RF) was associated with lower IKDC ($r=0.416$, $p=0.035$) and Lysholm score ($r=0.429$, $p=0.029$) and poorer LSI during single leg hop test ($r=0.455$, $p=0.034$).

d) **Discussion and conclusion:** Muscle stiffness of medial quadriceps was found to be decreased in patients with ACLR, especially for those who did not return to play. Deceased quadriceps stiffness was associated with poor knee function and quadriceps performance. Although the stiffness of medial hamstring also showed a decrease after harvesting the hamstring tendon, it may not affect knee and muscle function. Therefore, deficit in quadriceps stiffness should be addressed during post-ACLR rehabilitation. The effect of modulation of the quadriceps muscle stiffness on improving knee function and quadriceps performance warrants future investigation.

e) **Reference:**

1. Sigrist RM, Liau J, El Kaffas A, Chammas MC, Willmann JK. Ultrasound elastography: review of techniques and clinical applications. Theranostics. 2017;7(5):1303.
2. Irrgang JJ, Anderson AF, Boland AL, Harner CD, Kurosaka M, Neyret P, et al. Development and validation of the international knee documentation committee subjective knee form. Am J Sports Med. 2001;29(5):600-13.

3. Tegner Y, Lysholm J. Rating systems in the evaluation of knee ligament injuries. Clin Orthop. 1985(198):43-9.

4. Sueyoshi T, Nakahata A, Emoto G, Yuasa T. Single-leg hop test performance and isokinetic knee strength after anterior cruciate ligament reconstruction in athletes. Orthopaedic journal of sports medicine. 2017;5(11):2325967117739811.

Oral Presentation (Original Research)

Session 2: Sports Medicine

Effectiveness of Tai Chi to Alleviate Metabolic Syndrome in Centrally Obese Older Adults: A Randomized Controlled Trial

Angus P.H. Yu[1], *Doris S.F. Yu*[2], *Stanley S.C. Hui*[3], *Jean Woo*[4], *Parco M.F. Siu*[1]
[1] Division of Kinesiology, School of Public Health, Li Ka Shing Faculty of Medicine, The University of Hong Kong, Pokfulam, Hong Kong, China;
[2]The Nethersole School of Nursing, Faculty of Medicine, The Chinese University of Hong Kong, Shatin, Hong Kong, China;
[3]Department of Sports Science and Physical Education, Faculty of Education, The Chinese University of Hong Kong, Shatin, Hong Kong, China;
[4]Department of Medicine, Faculty of Medicine, The Chinese University of Hong Kong, Shatin, Hong Kong, China

Objective

Metabolic syndrome (MetS) is a cluster of cardiovascular risk factors including central obesity (CO), high blood pressure, elevated fasting blood glucose, hypertriglyceridemia and low high-density lipoprotein-cholesterol (HDL-C)[1]. Individuals with MetS are more susceptible to the development of diabetes and cardiovascular diseases. CO is regarded as an essential component of MetS under the definition of International Diabetes Federation[1]. Indeed, CO shows high comorbidity with other cardiovascular risk factors. Tai Chi is a popular exercise modality among Chinese older population that is suitable for them to be incorporated in their daily life for managing cardiovascular risk factors of MetS. The aim of this study was to examine the effectiveness of Tai Chi training on MetS parameters in centrally obese older adults thus prevent or alleviate the progression of MetS development.

Methods

This study was a randomized, controlled, three-arm, single-blinded trial. Participants aged ≥50 with central obesity (waist circumference ≥ 90 cm for male, ≥ 80 cm for female) were recruited. They were randomly assigned to Control, Exercise and Tai Chi groups. Participants in Exercise and Tai Chi groups received 12-week (3 sessions per week; total of 36 training sessions) for generic exercise and Tai Chi training, respectively, whereas participants in Control group received no intervention. Outcomes were assessed at baseline and completion of intervention (post assessment). The primary endpoint of this study was waist circumference (WC). The secondary endpoints were the systolic blood pressure (SBP), diastolic blood pressure (DBP), fasting blood glucose (GLU), blood triglycerides (TG), HDL-C in centrally obese older adults. Data was analyzed by Generalized Estimated Equation with baseline as covariate. Pairwise comparison was done by closed test procedure.

Results

A total 543 participants were recruited and randomized in the study (Control: n=181, Exercise: n=181, Tai Chi: n=181). Among the 543 participants, there were 427 participants (Control: n=138, Exercise: n=145, Tai Chi: n=144) completed the post assessment. Tai Chi group showed a significantly better improvement in WC compared with the Exercise and Control groups, while the reduction in WC of Exercise group was larger than Control group. The reduction in triglycerides was significantly larger in Exercise and Tai Chi groups compared with Control group. Sub-analysis with data of centrally obese older adults with low HDL-C also showed that both exercise and Tai Chi trainings increased HDL-C.

Conclusion

A 12-week Tai Chi training is an effective intervention to alleviate the progression of MetS by improving central obesity and lipid profile.

Reference

1. Alberti KG, Zimmet P, Shaw J, Group IDFETFC. The metabolic syndrome--a new worldwide definition. *Lancet.* 2005;366(9491):1059-1062.

Development of an All-Suture Anchor for a Rat Rotator Cuff Tear Model

Yang LIU[1], *Sai Chuen FU*[1,2], *Hio Teng LEONG*[1], *Patrick Shu-Hang YUNG*[1].
[1]Department of Orthopaedics & Traumatology, Faculty of Medicine,
The Chinese University of Hong Kong, Hong Kong SAR, China
[2] Lui Che Woo Institute of Innovative Medicine, Faculty of Medicine,
The Chinese University of Hong Kong, Hong Kong SAR, China

Objective:
Rotator cuff (RC) injury is a major cause of shoulder pain and functional loss. The reported re-tear rate after surgical repair varied from 21.4%[1] to 94%[2]. Animal models play a vital role for pre-clinical studies. Since the rats have similar anatomy and function to human [3], the rat RC tear model has been well-established and it is widely used for investigating the biological promotion effects of various interventions. However, only traditional transosseous repair is applicable in this animal model, while in clinic, suture anchor is the most common technique for RC repair. To better understand the mechanism of healing process and exploring methods to enhance healing after surgical repair, it is essential to perform a more relevant repairing method in the animal model. This study aimed to investigate the feasibility of a custom-made all-suture anchor on a rat model of RC injury and to compare its histological and biomechanical outcomes with the traditional transosseous repairing method.

Methods:
Twenty-two male Sprague Dawley rats (weighted 450-500g) were used in the study. The supraspinatus tendons were detached with scalpel and repaired immediately in transosseous manner (TO, n=11) or with a custom-made all-suture anchor (AS, n=11). Rats were euthanized at 2 weeks and 4 weeks post-repair for histological investigation. Overall healing quality was assessed semiquantitative with a scoring system. The biomechanical properties including load to failure, stiffness and failure mode were assessed at 4 weeks post-repair. Statistical analysis was performed using Student's t-test. Significance was set at $p<0.05$.

Results:
All rats survived from the surgical procedures. One rat in the TO group presented glenohumeral joint infection therefore it was removed from further assessments. Histomorphology showed the surgical fixation all remained intact at the insertion site at 2 and 4 weeks. The anchor part of the all-suture anchor was secured inside the greater tuberosity at both 2 and 4 weeks. The cellularity and vascularity in the healing area of the AS group was higher to that of the TO group at both 2 and 4 weeks. In both groups, the cellularity and vascularity relieved at 4 weeks compared with 2 weeks. During biomechanical test, the supraspinatus tendon-to-bone complex failed at the interface in all the samples. The load to failure of the repaired tendon in the TO group was significantly higher than that of the AS group (16.18±3.27 N v.s. 10.92±4.37 N, $p=0.047$). No significant difference between the tendon stiffness between the TO and AS groups (11.32±1.45 N/mm vs. 8.90±3.28 N/mm, $p=0.157$).

Discussion and conclusion:
The general healing outcome of the AS is inferior than the TO group, which highlight the importance of choosing this more clinically relevant model for further healing-enhancement related studies. The difference in histological healing outcome is probably because the anchor implantation triggered different healing response to the healing site. As the all-suture anchor repair could not secure a good surgical outcome, we need to upgrade it with additional function to promote biological healing. Furthermore, this all-suture anchor for the rat model could be potentially modified as a precise carrier of various bioactive molecules to enhance the tendon-to-bone healing.

Reference:

1. Slabaugh MA, Nho SJ, Grumet RC, Wilson JB, Seroyer ST, Frank RM, et al. Does the Literature Confirm Superior Clinical Results in Radiographically Healed Rotator Cuffs After Rotator Cuff Repair? Arthroscopy: The Journal of Arthroscopic & Related Surgery 2010;26(3):393-403.
2. Vastamäki M, Lohman M, Borgmästars N. Rotator Cuff Integrity Correlates With Clinical and Functional Results at a Minimum 16 Years After Open Repair. Clinical Orthopaedics and Related Research® 2012;471(2):554-61.
3. Soslowsky LJ, Carpenter JE, DeBano CM, Banerji I, Moalli MR. Development and use of an animal model for investigations on rotator cuff disease. J Shoulder Elbow Surg 1996;5(5):383-92. [eng].

The Effects of Shoe Collar Height on Ankle Sprain Prevention: A Systematic Review

Jojo Hoi-Ching LAI, Samuel KK LING, SW MOK, Patrick SH YUNG
Department of Orthopaedics and Traumatology, Faculty of Medicine, CUHK

Objective
Our aim was to conduct a systematic review to establish the effects of shoe collar height in relation to lateral ankle sprain prevention, so as to provide rationales regarding potential recommendations for the use of high-top shoes in athletes.

Methods
A systematic search of four databases (EMBASE, Medline, SPORTDiscus, and PubMed) was conducted from inception to September 2019. Titles, abstracts and full-text articles were screened for inclusion. Primary outcome measures included number of ankle injuries, ankle range of motion, and ankle muscle function.

Results
11 randomized controlled trials published from 1993 – 2018 were included.[1-11] Most included studies did not show convincing results to support that high-top shoes are useful to prevent ankle sprains, although a few suggested they may alter ankle biomechanics and affect athletic performance. Due to heterogeneity of testing protocols, outcome measurements, and lack of consensual definition of high-top shoes, pooling of results was difficult and should be interpreted with caution.

Discussion
Multiple new studies on the effect of shoe collar height on ankle sprain injuries and kinematics since the last relevant review in 2001 warrant an update on this topic. This is the first systematic review known to us that explicitly investigates such subject in detail. There is currently weak evidence to support the statement of high-top shoes being useful to prevent ankle sprains in the young adult athletic population. Future studies could include (i) more comprehensive shoe description; (ii) testing protocols which better resemble actual ankle sprain kinetics; as well as (iii) electromyographic studies on how shoe collar height may influence intrinsic neuromuscular response of ankle muscles.

References

1. Ashton-Miller JA, Ottaviani RA, Hutchinson C, Wojtys EM. What best protects the inverted weightbearing ankle against further inversion? evertor muscle strength compares favorably with shoe height, athletic tape, and three orthoses. Am J Sports Med. 1996;24(6):800-809.
2. Barrett JR, Tanji JL, Drake C, Fuller D, Kawasaki RI, Fenton RM. High- versus low-top shoes for the prevention of ankle sprains in basketball players. A prospective randomized study. Am J Sports Med. 1993;21(4):582-585.
3. Brizuela G, Llana S, Ferrandis R, Garcia-Belenguer AC. The influence of basketball shoes with increased ankle support on shock attenuation and performance in running and jumping. J Sports Sci. 1997;15(5):505-515.
4. Fu W, Fang Y, Liu Y, Hou J. The effect of high-top and low-top shoes on ankle inversion kinematics and muscle activation in landing on a tilted surface. J Foot Ankle Res. 2014;7(1):14-1146-7-14.
5. Lam GW, Park EJ, Lee KK, Cheung JT. Shoe collar height effect on athletic performance, ankle joint kinematics and kinetics during unanticipated maximum-effort side-cutting performance. J Sports Sci. 2015;33(16):1738-1749.
6. Ottaviani RA, Ashton-Miller JA, Kothari SU, Wojtys EM. Basketball shoe height and the maximal muscular resistance to applied ankle inversion and eversion moments. Am J Sports Med. 1995;23(4):418-423.

7. Ottaviani RA, Ashton-Miller JA, Wojtys EM. Inversion and eversion strengths in the weightbearing ankle of young women. effects of plantar flexion and basketball shoe height. Am J Sports Med. 2001;29(2):219-225.
8. Pizac DA, Swanik CB, Glutting JJ, Kaminski TW. Evaluating postural control and ankle laxity between taping and high-top cleats in high school football players. J Sport Rehabil. 2018;27(2):111-117.
9. Ricard MD, Schulties SS, Saret JJ. Effects of high-top and low-top shoes on ankle inversion. J Athl Train. 2000;35(1):38-43.
10. Vanwanseele B, Stuelcken M, Greene A, Smith R. The effect of external ankle support on knee and ankle joint movement and loading in netball players. J Sci Med Sport. 2014;17(5):511-515.
11. Yang Y, Fang Y, Zhang X, He J, Fu W. Does shoe collar height influence ankle joint kinematics and kinetics in sagittal plane maneuvers? J Sports Sci Med. 2017;16(4):543-550.

Are Running Biomechanics the Cause of High Injury Risk in Trail Runners?

Sin Ming Li[1], Hio Teng Leong[1],Zoe Yau Shan Chan[2], Janet Hanwen Zhang[2], Peter Pak Kwan Chan[2], Roy Tsz Hei Cheung[2,]
[1]Department of Orthopaedics & Traumatology, The Chinese University of Hong Kong
[2]Gait & Motion Analysis Laboratory, Department of Rehabilitation Sciences, The Hong Kong Polytechnic University

Abstract: Trail running is one of the fastest growing sports in Hong Kong (1). However, running injury is extremely common and the injury prevalence of trail runners is even higher than road runners (2,3). Previous studies suggested that high vertical loading rate and gait asymmetry may be associated with running injury (4,5). Meanwhile, footstrike pattern and stride length have been reported to influence the vertical loading rate (6–8). This study sought to examine if trail and road runners exhibit different running biomechanics related to injury development. Specifically, we compared the vertical loading rate, footstrike pattern, stride length and symmetry between trail and road runners.

Methods: Ten trail runners and nineteen road runners were recruited from local running clubs. Reflective markers were placed on the participants and marker trajectory was recorded using a motion analysis system. All participants ran on an instrumental treadmill with their usual running shoes for 10 minutes at self-selected speed. Vertical average and instantaneous loading rate, footstrike angle, stride length and related symmetry indices were measured during the last minute of running trial. Two tailed independent t-tests and Kruskal-Wallis test were used to compare the biomechanical parameters.

Results: There were no significant difference between trail and road runners on all dependent variables ($p>0.128$). While high vertical loading rate was expected in rearfoot strikes as reported by previous studies, subsequent analyses were performed on rearfoot strikers for both trail and road runners. All biomechanical variables and symmetry indices were similar between two streams of runners ($p>0.102$).

Discussion and Conclusion: This is the first study to examine the biomechanical difference between trail and road runners. There were no significant differences in vertical loading rate, footstrike pattern, stride length and symmetry indices between two streams of runners. The running biomechanics may not be the major risk factor related to the higher injury risk in trail runners. Further research is needed to explain the higher injury incidence among trail runners.

Reference

1. Eight standout races in Hong Kong this winter PLUS full running calendar [Internet]. South China Morning Post. 2016 [cited 2019 Mar 22]. Available from: https://www.scmp.com/lifestyle/health-beauty/article/2038998/8-standout-races-hong-kong-winter-plus-full-running-calendar

2. Krabak BJ, Waite B, Schiff MA. Study of Injury and Illness Rates in Multiday Ultramarathon Runners: Medicine & Science in Sports & Exercise. 2011 Dec;43(12):2314–20.

3. Brukner PDF, Bennell KL, Malcolm SA, Thomas SA, Wark JD, Ebeling PR. The Incidence And Distribution Of Stress Fractures In Track And Field Athletes: A Prospective Study: 1103. Medicine & Science in Sports & Exercise. 1995 May;27(5).

4. Davis IS, Bowser BJ, Mullineaux DR. Greater vertical impact loading in female runners with medically diagnosed injuries: a prospective investigation. Br J Sports Med. 2016 Jul 1;50(14):887–92.

5. Perttunen JR, Anttila E, Södergård J, Merikanto J, Komi PV. Gait asymmetry in patients with limb length discrepancy. Scandinavian Journal of Medicine & Science in Sports. 2004;14(1):49–56.

6. Shih Y, Lin K-L, Shiang T-Y. Is the foot striking pattern more important than barefoot or shod conditions in running? Gait & Posture. 2013 Jul 1;38(3):490–4.

7. Stergiou N, Bates BT, Kurz MJ. Subtalar and knee joint interaction during running at various stride lengths. J Sports Med Phys Fitness. 2003 Sep;43(3):319–26.

8. Huang Y, Xia H, Chen G, Cheng S, Cheung RTH, Shull PB. Foot strike pattern, step rate, and trunk posture combined gait modifications to reduce impact loading during running. Journal of Biomechanics. 2019 Mar 27;86:102–9.

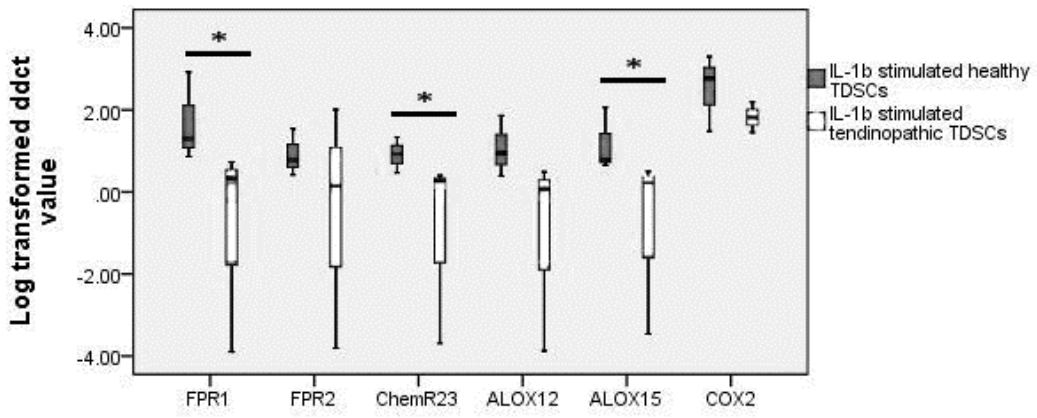
High Glucose Environment can be a Cause to Tendinopathy via Exaggerated Inflammation and Weakened Pro-Resolving Response

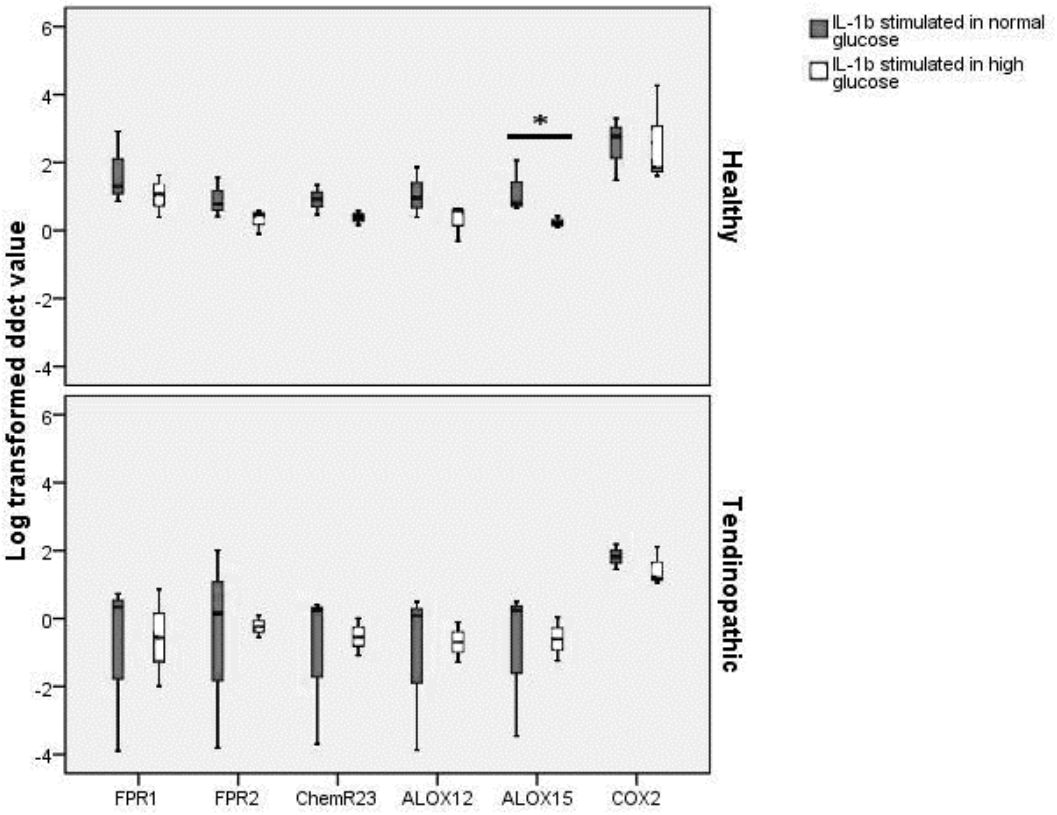
Kwan CK[1,2], Fu SC[1,2], Rolf CG[3], Yung SH[1,2],
[1]Department of Orthopaedics and Traumatology, Faculty of Medicine, The Chinese University of Hong Kong
[2] Lui Che Woo Institute of Innovative Medicine, The Chinese University of Hong Kong
[3] Division of Orthopaedics and Biotechnology, CLINTEC, Karolinska Institute

Objectives: Tendinopathy is a chronic disorder that affects a huge population, and is causing high socioeconomical impacts worldwide.[1] The pathogenesis of tendinopathy is suggested to be multifactorial, but the exact mechanism remains unclear. Tendinopathy was reported to be more prevalent in diabetic patients.[2] Chronic inflammation was proposed to play an important role in its development, and it was suggested that chronic inflammation could be caused by a persistent stimulus or a weakened pro-resolving pathway of inflammation.[3] It was previously reported that a high glucose environment may lead to enhanced inflammation, and high glucose is also associated with suppressed proliferation and increased apoptosis of tendon cells. There is a possibility that the high glucose environment in diabetic patients lead to chronic inflammation in the tendon, and eventually the development of tendinopathy. In this study, we simulated the diabetic environment in an in vitro setup, to assess the effect of a high glucose level on cultured tendinopathic and healthy tendon derived stem cells (TDSCs). We also assessed the possibility whether a high glucose level might lead to changes in the inflammatory response in tendon cells, and to discuss whether the control of glucose levels could be beneficial in the management or prevention of tendinopathy.

Methods: Tendinopathic TDSCs were cultured from 2 torn rotator cuff tendons and 1 ruptured patellar tendon. Healthy TDSCs were cultured from 3 gender matched healthy hamstring tendons. Cells were stimulated by either 2ng/ml IL-1B for 24 hours, 11.1 mmol/L glucose for 24 hours, or both. mRNA was collected and processed for qPCR targeting B-actin, ALOX12, ALOX15, FPR1, FPR2, ChemR23, and COX2.

Results: Upregulation of FPR1 (p=0.050) ChemR23 (p=0.050), ALOX15 (p=0.050) was significantly weakened when comparing tendinopathic and healthy TDSCs stimulated with IL-1b. The upregulation of ALOX15 (p=0.050), was significantly lower in stimulated healthy TDSCs in a high glucose environment when comparing with those stimulated under a regular glucose level. A high glucose level also induced upregulation of COX2 (p=0.046) in healthy TDSCs and tendinopathic TDSCs (p=0.050).





*Discussion and Conclusion***:** The results of this study suggest that the weakening of the pro-resolving pathway is observed in tendinopathic tendon cells. It was also found that a high glucose environment may lead to this change in healthy tendon cells. This finding provides a possible explanation to the increased risk to develop tendinopathy in diabetic patients. The direct effects of a high glucose environment on tendon cells may contribute to a weakened pro-resolving pathway in healthy TDSCs. Along with previously described factors such as AGE deposition, adipokine dysregulation and more[4], the weakening of pro-resolving responses in tendinopathic TDSCs may contribute to chronic inflammation and development of tendinopathy in diabetic patients. Clinically, this piece of information may be valuable as it suggests a possibility that strict control of glucose levels may have an effect in preventing the development of tendinopathy in the currently asymptomatic population.

References:

1. Hopkins C et al. Critical review on the socio-economic impact of tendinopathy. *AP-SMART*. 2016;4:9-20

2. Abate M et al. Occurrence of tendon pathologies in metabolic disorders. *Rheumatology* 2013;52(4)

3. Dakin SG et al. Chronic inflammation is a feature of Achilles tendinopathy and rupture. *BJSM*. November 2017

4. Lui PPY. Tendinopathy in diabetes mellitus patients—Epidemiology, pathogenesis, and management. *Scand J Med Sci Sports*. 2017;27(8)

Oral Presentation (Original Research)

Session 3: Exercise Science

Footstrike Pattern Classification of Using Footstrike Angle in Experienced, Novice and Non-runners

Shiwei Mo[1], *Meizhen Huang*[1], *Roy T. H. Cheung*[1]
[1]Gait & Motion Analysis Laboratory, Department of Rehabilitation Sciences, The Hong Kong Polytechnic University

Background: As an alternative of strike index (SI), footstrike angle (FSA) has been widely used to classify rearfoot, midfoot and forefoot strike patterns in runners. However, the FSA cutoff values to classify footstrike patterns varied in previous studies.[1-4] In addition, only one study[1] validated the method. Moreover, the validation study involved a small sample size (n=9) with a narrow range in the skill level,[1] which may limit the data generalizability.

Objectives: This study re-investigated the FSA cutoff values through recruiting a larger sample size and a greater variety of runners. We also compared the differences in the FSA cutoff values among runners with different running experience.

Methods: Fourteen (5F/9M) experienced runners (age=30.7±9.9 years, height=1.68±0.08 m, mass=64.5±10.8 kg), 15 (7F/8M) novice runners (age=30.5±8.2 years, height=1.68±0.09 m, mass=61.2±11.5 kg), and 14 (4F/10M) non-runners (age=27.0±2.2 years, height=1.68±0.07 m, mass=63.9±14.1 kg) were recruited. They were asked to run on an instrumented treadmill for 3 minutes at their preferred running speeds using habitual, rearfoot, midfoot and forefoot strike patterns in a random order. Synchronized kinematic and kinetic data were recorded for 30 seconds at the last minute of each condition. SI and FSA of all right footfalls were extracted for analyses.[1]

Regression analysis was performed to determine the correlation between FSA and SI for each subject group. All midfoot strikes were firstly detected using SI (i.e., SI=33.3~66.7%[1,5]). The corresponding FSAs were then extracted to establish the cutoff values to determine a midfoot strike pattern.

Results: We collected a total of 7,359 footfalls (experienced=2,625; novice=2,504; non-runners=2,230). The linear regression model is presented in Figure 1 and the relationship between FSA and SI are expressed in the following equations:

All runners: $FSA = -0.3129 \times SI + 18.57$, R^2=0.74

Experienced runners: $FSA = -0.3293 \times SI + 19.06$, R^2=0.80

Novice runners: $FSA = -0.3207 \times SI + 19.13$, R^2=0.75

Non-runners: $FSA = -0.2796 \times SI + 17.23$, R^2=0.65

A total of 791, 1,000 and 667 midfoot strikes were classified for the experienced, novice and non-runners, respectively. In view of our non-normally distributed dataset (p<0.001), we used the 5th (lower) and 95th (upper) percentiles to define the cutoff boundaries of a midfoot strike. The FSA cutoff values were -2.4-8.6°, -3.7-9.3°, and -2.8-10.0° for experienced, novice and non-runners respectively (Figure 2). If we pooled all midfoot strikes regardless of participants' skill level, the upper and lower boundaries of FSA were -3.2-9.3°.

The FSA for habitual footstrike pattern in the experienced, novice and non-runners were 8.86±3.30°, 7.03±6.27° and 9.89±5.23°, respectively. We found a significant group differences in the habitual FSA variability (F=5.72, p=0.007) and the variability in the experienced runners (0.97±0.39°) were smaller than non-runners (1.39±0.37°, p=0.012).

Discussion and Conclusion: Using a larger sample size, we found different FSA cutoffs when compared with the previous validation study[1]. Such discrepancy could be due to the number of midfoot strikes being analyzed. In the present study, we analyzed 2,458 midfoot strikes and there were only 9 midfoot strikes in the previous study[1]. Our findings also suggested that the FSA cutoff values could be affected by running experience. When compared with novice and non-runners, a narrower FSA window to define midfoot strike in experienced runners could be explained by a lower FSA variability than the other two groups.

In summary, we have based on a larger sample size and established new cutoff values to determine footstrike patterns using FSA. Running experience should be considered when FSA is adopted to classify footstrike pattern in runners.

References

1. Altman, A. R., & Davis, I. S. (2012). A kinematic method for footstrike pattern detection in barefoot and shod runners. *Gait Posture, 35*, 298-300.
2. Eskofier, B. M., Musho, E., & Schlarb, H. (2013). Pattern classification of foot strike type using body worn accelerometers. In *2013 IEEE International Conference on Body Sensor Networks* (pp. 1-4). IEEE.
3. Lieberman, D. E. (2014). Strike type variation among Tarahumara Indians in minimal sandals versus conventional running shoes. *J Sport Health Sci, 3*(2), 84-94.
4. Lieberman, D. E., Castillo, E. R., Otarola-Castillo, E., Sang, M. K., Sigei, T. K., Ojiambo, R., ... & Pitsiladis, Y. (2015). Variation in foot strike patterns among habitually barefoot and shod runners in Kenya. *PLoS One, 10*(7), e0131354.
5. Cavanagh, P. R., & Lafortune, M. A. (1980). Ground reaction forces in distance running. *J Biomech, 13*(5), 397-406.

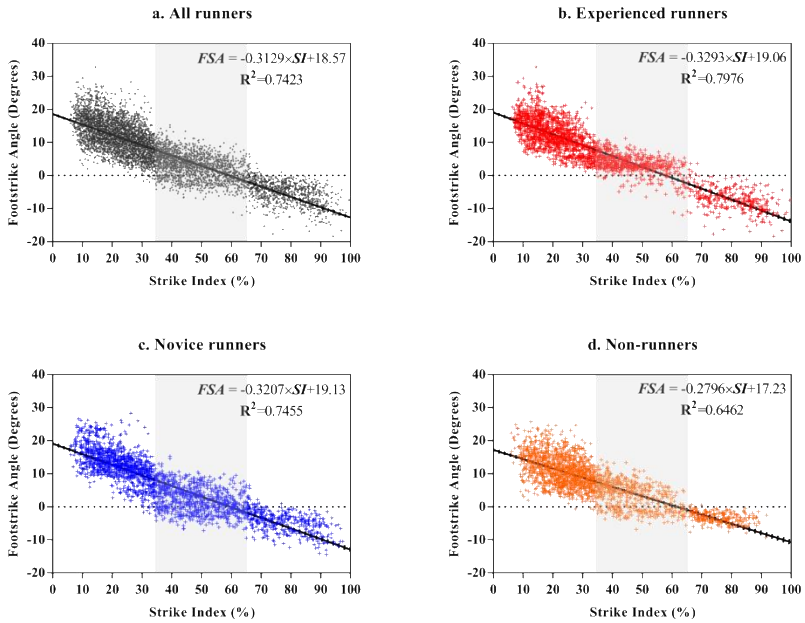


Figure 1. Regression models between footstrike angle (FSA) and strike index (SI) for (a) all runners, (b) experienced runners, (c) novice runners, and (d) non-runners.

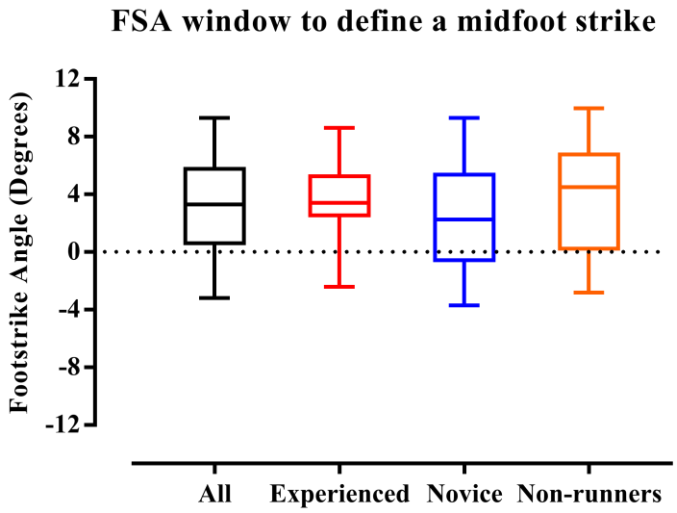


Figure 2. Footstrike angle distribution of the footfalls classified as midfoot strike for all runners and sub-groups (experienced, novice and non-runners).

Effectiveness of an In-Field Running Retraining Using a Footstrike Pattern Feedback System

Zoe Yau-Shan Chan, Peter Pak-Kwan Chan, Ben Man-Fung Lam, Nemo Shiwei Mo, Roy Tsz-Hei Cheung
Gait & Motion Analysis Laboratory, Department of Rehabilitation Sciences,
The Hong Kong Polytechnic University, Hong Kong

Objectives

Overuse injuries are common among runners with a reported incidence of 7.7 injuries per 1,000 hours of running (1). The development of overuse injuries has been largely attributed to repetitive collisions between the body and the ground. The cumulation of repeated impact stress applied to a specific musculoskeletal structure could result in an overuse injury and could be avoided by reducing the impact stress to below the injury threshold (2).

Aimed at reducing impact stress, gait retraining using real-time biofeedback has gained popularity in both clinical and research settings (3). Transition to a more anterior footstrike pattern with feedback as guidance was found effective in reducing impact loading in runners (4). However, real-time feedback often requires complicated setup and advanced equipment that may not be available within runner's natural training environment. Fortunately, there is a technological breakthrough in the detection of footstrike pattern (5). A newly validated method using force sensors placed at the heel and forefoot region within an insole has been proposed. The onset time difference between the sensors can be used to classify each footstrike into rearfoot (RFS), midfoot (MFS) and forefoot (FFS) strike. This simple footstrike detection method has made in-field training to modify footstrike pattern feasible.

Hence, the present study sought to evaluate the effect of a gait retraining using a novel footstrike feedback system. Specifically, to evaluate the change in footstrike pattern and vertical loading rate (VLR), a key biomechanical marker for running-related injuries (6). Apart from level running, the training effect translation to sloped surfaces (uphill and downhill) were also evaluated.

Methods

16 habitual RFS runners (13 males, 3 females) completed the study. During the pre- and post-training assessments, participants were asked to completed three running trials on an instrumented treadmill (AMTI, USA) with inclination set at 0° (Level), +10° (Uphill) and -10° (downhill). Footstrike angle and ground reaction force were sampled using an 8-camera motion capturing system (VICON, UK) and treadmill respectively during the last minute of each five-minute trial. The footstrike pattern was determined based on the reported footstrike angle cut-offs (RFS>8°>MFS>-1.6°>FFS) (7). VLR was obtained from the vertical ground reaction force by the algorithm reported previously (6).

Each participant completed a two-week gait retraining program in a standard 400 m running track (Figure 1). During the training, a pair of size-matched footstrike sensing insole was connected to a smartphone app. The participants were instructed to avoid RFS. Audio feedback indicating each footstrike pattern (RFS: Low; MFS: Mid; FFS: High) was provided each time a right footfall was detected.

Results

In the post-training assessment, 75% (12 out of 16) of the participants demonstrated non-RFS pattern during level running. Results of paired t-tests showed a significant reduction in footstrike angle and VLR among all conditions (Table 1).

Discussion and Conclusion

This in-field gait retraining, which utilized a real-time footstrike feedback system, was found effective in promoting non-RFS and reducing VLR in the majority of runners. Similar to a recently published

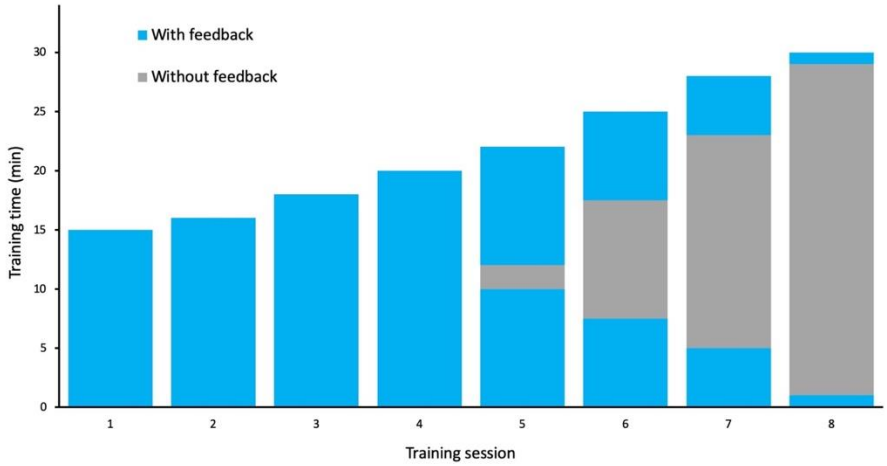
gait retraining study (8), trained runners were found to be able to translate the training effect to sloped running.

References
1. Videbæk S, Bueno AM, et al. *Sports Med Auckl Nz.* 2015;45(7):1017–26.
2. Hreljac A. *Phys Med Rehabil Clin N Am.* 2005 Aug 1;16(3):651–67.
3. Agresta C, Brown A. *J Orthop Sports Phys Ther.* 2015 Aug;45(8):576–84.
4. Cheung RTH, Davis IS. *J Orthop Sports Phys Ther.* 2011 Dec;41(12):914–9.
5. Cheung RTH, An WW, et al. *PloS One.* 2017;12(6):e0175724.
6. Davis IS, Bowser BJ, et al. *Br J Sports Med.* 2016 Jul;50(14):887–92.
7. Altman AR, Davis IS. *Gait Posture.* 2012 Feb;35(2):298–300.
8. Zhang JH, Chan ZYS, et al. *Gait Posture.* 2019 Mar 1;69:8–12.

Table 1. Footstrike angle and vertical loading rate before and after gait retraining

	Pre-training	Post-training	*p*-value	Cohen's *d*
Footstrike angle (°)				
Level	14.39±3.16	3.90±6.46	<0.01*	2.06
Uphill	7.53±3.06	2.44±3.64	<0.01*	1.51
Downhill	7.69±10.26	0.04±6.89	0.01*	0.88
Vertical loading rate (BW/s)				
Level	115.33±28.08	82.23±32.46	<0.01*	1.09
Uphill	67.32±16.80	50.64±19.13	<0.01*	0.93
Downhill	104.39±36.35	78.88±35.52	0.03*	0.71

BW: Bodyweight



* $p<0.05$

Figure 1. The training protocol was adopted from previous gait retraining studies (4,8). Feedback was gradually removed from the last 4 training sessions.

Effects of Pose® Method Gait Retraining on Running Biomechanics in Distance Runners

Rachel Wei[1], *Ivan Au*[2], *Fannie Lau*[1], *Janet Zhang*[2], *Zoe Chan*[2], *Aislinn MacPhail*[2], *Anamaria Mangubat*[2], *Gabriel Pun*[2], *Roy Cheung*[2]
1 Department of Orthopaedics & Traumatology, The Chinese University of Hong Kong, Sha Tin, Hong Kong
2 Department of Rehabilitation Sciences, The Hong Kong Polytechnic University, Hung Hom, Hong Kong

Background and Objective Emerging evidence suggests high vertical loading rates relates to the development of running injuries (1). Runners usually seek help from running coaches for gait modification because of the limited access to biomechanics laboratories. Pose® Method gait retraining is a coach-based program in which coaches provide verbal cues and video feedback to modify running posture for injury prevention (2). This study examined the vertical loading rates, the lower extremity kinematics and trunk posture before and after Pose® Method gait retraining.

Method Fourteen runners underwent an eight-session Pose® Method gait retraining program delivered by a certified coach. Before and after the program, all participants were asked to run overground with their own usual running shoes at their usual speed on a flat, straight, 20-m runway embedded with force platforms. Reflective markers were firmly affixed onto specific bony landmarks according to a previously established model (3). A 10-camera motion capturing system was used to capture the trajectory of the markers during running. Paired t-tests were employed to compare vertical average (VALR) and instantaneous loading rates (VILR), lower limb kinematics, footstrike angle and trunk flexion in the sagittal plane before and after the training.

Results Kinetically, there were no significant differences in the VALR (p= 0.693) and VILR (p= 0.782) before and after the training. Kinematically, participants exhibited greater peak hip flexion (p= 0.008) and knee flexion (p= 0.003) during swing. Footstrike angle also reduced significantly (p= 0.008), indicating a footstrike pattern switch from rearfoot strike to midfoot strike. There was no significant difference in the trunk flexion in the sagittal plane after training (p= 0.658).

Discussion and Conclusion After a course of Pose® Method gait retraining, runners demonstrated a footstrike pattern switch and some kinematics changes at the hip and knee joint during swing. This may be related to the fact that Pose® Method gait retraining program aims for landing on the ball-of-foot and readjusting the lower extremity alignment (2). When compared with these visible biomechanical parameters, injury-related biomechanical markers (i.e., VALR and VILR) remained similar after training. Running coaches may not be able to detect heavy footfalls. In addition, the small changes in the spine movement may be difficult to be visualized by coaches and perceived by the runners. In view of the close relationship between vertical loading rates and running-related musculoskeletal injuries (1), Pose® Method gait retraining may not lower injury risk. Runners may consider other gait retraining programs for impact loading reduction, such as laboratory-based retraining with real-time feedback (4).

Reference

1. Cheung RT, Davis IS. Landing pattern modification to improve patellofemoral pain in runners: a case series. The Journal of orthopaedic and sports physical therapy. 2011;41(12):914-9.

2. Romanov, N. (2004). Moving from thought to action. In S. Romanov (Ed.), Dr. Nicholas Romanov's Pose method of running (pp. 97–131). Miami, FL: PoseTech Press.

3. Altman, A. R., & Davis, I. S. (2012). A kinematic method for footstrike pattern detection in barefoot and shod runners. Gait and Posture, 35, 298–300.

4. Chan, Z. Y., Zhang, J. H., Au, I. P., An, W. W., Shum, G. L., Ng, G. Y., & Cheung, R. T. (2018). Gait retraining for the reduction of injury occurrence in novice distance runners: 1-year follow-up of a randomized controlled trial. The American Journal of Sports Medicine, 46, 388–395.

Time Required to Familiarize a Novel Footwear Condition for Treadmill Running Test

Peter Pak-Kwan Chan[1], *Meizhen Huang*[1], *Roy Tsz-Hei Cheung*[1]
[1]Gait & Motion Analysis Lab, Department of Rehabilitation Sciences, The Hong Kong Polytechnic University

Objectives

Treadmill tests have been extensively used in running footwear studies. Duration for treadmill familiarization, defined as a state with no significant kinematic or kinetic differences across strides (1), was well studied. Currently, adaptation period in treadmill based shod running test was established based on the duration for treadmill familiarization, with the duration for familiarizing a novel footwear remained unexplored. Thus, this study aimed to investigate the time required to habituate a novel shoe condition for treadmill running test.

Methods

Twelve young adults (age: 26.1 ± 4.1 years) free from cardiopulmonary condition and active musculoskeletal injury completed three 10-minute running trials at their preferred running speed (8.36±6.36 km/h) on an instrumented treadmill (AMTI, Watertown, MA, USA). In each trial, participants were instructed to run with one of the selected test shoes in a randomized order, including participants' usual shoes, minimalist running shoes and maximalist running shoes.

Lower limb joint kinematics was measured using an inertial measurement units based motion-capturing system (myoMOTION MR3.14, Noraxon, Arizona, USA). Kinematics of the hip, knee and ankle joints of the dominant leg were evaluated. For each minute, the first ten cycles from the lower limb kinematic curve were extracted. The extracted data were then time normalized and averaged for obtaining per-minute kinematic curves.

Symmetry measures including trend symmetry index, range amplitude ratio and range offset were computed between the per-minute kinematic curves of the first nine minutes and the per-minute kinematic curve of the last minute (2, 3). Trend symmetry index is a quantitative measure of pattern similarity between two kinematic curves (2). A value of zero indicates perfect asymmetry, and one indicates perfect symmetry. Values ≥ 0.95 were considered as highly similar between two kinematic curves (2, 3). Range amplitude ratio compared the range of motion between two kinematic curves while range offset quantified the differences in operating range between two curves.

Differences in the symmetry measures with different footwear conditions were compared using two-way repeated measures ANOVA [running shoes (3 levels) x time (9 levels)] for each joint. Post-hoc paired t-tests were conducted if significant main effects indicated. Familiarization time was determined when no significant difference was found between the similarity values of a time point and the last similarity measurements. A significance level was set as $p \leq 0.05$.

Results

For trend symmetry index, only significant time effect was observed for ankle, knee and hip joints ($p<0.001$, $\eta_p^2=0.501$-0.580).

For range amplitude ratio, significant time effect was observed for ankle ($p=0.001$, $\eta_p^2=0.441$), knee ($p=0.009$, $\eta_p^2=0.202$) and hip joints ($p<0.001$, $\eta_p^2=0.410$).

For range offset, there was significant interaction effect of running shoes × time ($p<0.001$, $\eta_p^2=0.206$), and significant time effect for the ankle joint ($p=0.001$, $\eta_p^2=0.419$).

Pairwise comparison indicated the familiarization time required for usual shoes, minimalist running shoes and maximalist running shoes were 6 minutes, 5 minutes and 6 minutes respectively.

Discussion and Conclusion

The current results showed that the duration required to habituate a shoe condition in a treadmill running test ranged from 5 to 6 minutes. Interestingly, there are no significant differences between the familiarization time across different footwear conditions. Our results showed a 6-minute adaptation period is sufficient for treadmill based shod running test, regardless of the type of footwear. This suggested that adaptation period in common protocols adopted in treadmill based shod running test was sufficient for familiarizing a novel footwear.

Reference

1. Schieb DA, *Res Q Exerc Sport*, 1986; 57:1-7.
2. Crenshaw SJ, Richards JG, *Gait Posture*, 2006; 24(4):515-21
3. Fellin R, Manal K, Davis I, *J Appl Biomech*, 2010; 26(4):407-14

Cross-Sectional Study of Surface Electromyography Activities on Shoulder Muscles of Elite Lifesaving Athletes

Daniel Hon-Ting TSE[1], *Beatrice Pui-Lun CHU*[1], *Sze-Nga FONG*[1], *Hoi-Kwan LO*[1], *Yiu-Cheung WONG*[1], *Sheung-Yau TONG*[1], *Billy Chun-Lung SO*[1]
[1]Department of Rehabilitation Sciences, The Hong Kong Polytechnic University

Objectives: Lifesaving sport is a competitive water sport demanding physical and mental agility[1], which involves many rescue techniques. Manikin carrying is deemed to be the most basic technique in competitive lifesaving. The athlete propels with one arm stroking and carries a 60-kg manikin with the other arm.[2] It exerts greatly on the carrying shoulder to stabilize the manikin throughout the race. Many lifesaving coaches are questioning that which shoulder muscles should be specifically trained to increase the stability of the manikin during carrying and hence enhance the performance. Therefore, this study aims to investigate the muscle activation profile of the carrying shoulder and the possible factors associated.

Methods: This was a cross-sectional study design. 20 young (aged between 12 and 25 years old) lifesaving athletes were recruited from the Hong Kong Lifesaving Society. Wireless surface electromyography (sEMG) was used to detect the muscle activity of the carrying shoulder during a 3-phase divided 25m Manikin Carrying. Motion analysis indicated that sustained shoulder internal rotation, extension and adduction are needed to counteract the gravity and water turbulence in the "Back-of-neck carry" style (Figure 1), which is a common form of manikin carrying.[3] Moreover, a preliminary EMG study was done to identify specific muscles with meaningful activation (at least 30%Maximum Voluntary Isometric Contraction (MVIC)) during manikin carrying. Hence, Posterior Deltoid (PD), Teres Major (TM) and Middle Trapezius (MT) were included in the study. Furthermore, the correlation between speed, number of inhalation, anthropometric characteristics such as first web space and grip strength and the shoulder muscle activities was investigated.

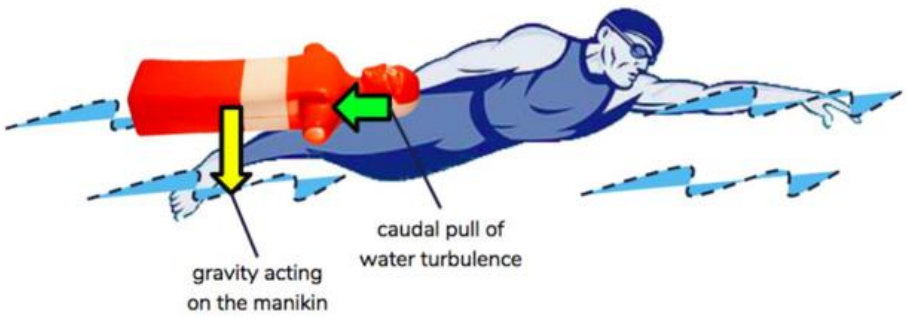


Figure 1. Two vector forces on the manikin during manikin carrying. Yellow arrow represents gravitational pull and green arrow represents caudal pull from the water turbulence

Results: TM showed muscle activity of 65.26%MVIC in initial phase and 64.35%MVIC in middle phase. Muscle activity of TM was found to have no association with any anthropometric

characteristics, speed and number of inhalation in both phases. MT showed 84.54%MVIC in initial phase and 68.54% MVIC in middle phase. Muscle activity of MT was found negatively associated with first web space ($p=0.002$) and grip strength ($p=0.005$) in initial phase, while it is negatively associated with speed ($p=0.001$), first web space ($p=0.001$), grip ($p=0.005$) and positively associated with number of inhalation ($p<0.001$) in middle phase. PD showed muscle activity of 55.73%MVIC in initial phase and 40.21%MVIC in middle phase. Muscle activity of PD was found negatively associated with speed ($p=0.038$) and first web space ($p=0.029$) in initial phase, while it is negatively associated with speed ($p=0.020$) and positively associated with number of inhalation ($p=0.022$) in middle phase.

Discussion and Conclusion: In general, the trend of the activation decreased in PD and MT, particularly in initial and middle phase. Meanwhile, TM maintained the activation consistently and did not associate with any other factors, suggesting its role in providing enduring stabilizing force to maintain the back-of-neck grip across time.

The negative correlations between first web space and MT and PD as well as the negative correlation between grip strength and MT in the initial phase, suggested some anthropometric characteristics like larger first web space and stronger handgrip are beneficial to lifesaving athletes.

The negative correlations between speed and muscle activities in all phases were due to the higher speed providing more uplifting torque to the manikin, resulting in lower muscle activities.

The positive correlations between number of inhalation and muscle activities were due to water turbulences created by upper body rotation during inhalation and higher muscle activations were required for compensation for stability.

To conclude, young elite athletes showed significant use of PD, TM and MT during manikin carrying. The muscle activity levels are correlated with first web space, grip strength, speed and number of inhalation of the athletes. At last, this study provided references for coaches on athletes' selection and skill training direction.

References:

1. Egyptian Diving and Lifesaving Federation. (2018). *About Lifesaving*. Retrieved October 3, 2018, from http://edlf-eg.org/en/sports-3/lifesaving/about-lifesaving
2. Amadeo F. S., Rafael P., Felipe D. L., Rogerio B. C., Eduardo S. P., Fabrizio C. (2014). Physiological and Metabolic Responses to Rescue Simulation in Surf Beach Lifeguarding. *J Exerc Physiol, 17*(3), 21-31.
3. Robert, K. S., Torill, H. (2012). *Lifesaving Competition: Speed vs Safety Conflict of Interest?*. Congreso International De Salvamento Y Socorrismo,2012. Retrieved October 3, 2018, from http://fessga.es/2012/Documentos/Full%20Text/I01%20-%20Stallman.pdf

Oral Presentation (Original Research)

Session 4: Exercise Science

A mHealth Intervention on Patients' Post-Surgery Rehabilitation Adherence: Test of Self-Determination Theory

Alfred Sing Yeung Lee[1], *Derwin King Chung Chan*[2], *Patrick Shu Hang Yung*[3], *Michael Tim Yun ONG*[3]
[1]School of Public Health, The University of Hong Kong
[2]Faculty of Education and Human Development, The Education University of Hong Kong
[3]Department of Orthopaedics and Traumatology, The Chinese University of Hong Kong

Objective: To examine the effectiveness of a self-determination theory (SDT)[1] driven smartphone application in facilitating anterior cruciate ligament (ACL) patients' post-surgery rehabilitation adherence.

Methods: Our study was a 4-month randomised control trial with three waves of assessment (i.e., baseline, 2-month, and 4-month). We recruited 95 outpatients (M_{age} = 27.81 ± 8.67, range = 18 to 53; Male = 60.82%) who undertook ACL reconstruction surgery for less than 2 weeks for this study. Participants were randomly assigned either into the intervention group (who received the smartphone application) and control group (who receive standard treatment only), and completed psychological measures relating to the theories (e.g., motivations and rehabilitation adherence) and clinical outcome measures (i.e. International Knee Documentation Committee subjective form (IKDC))[2] during the time of assessments. The SDT-driven smartphone application, "ACL-Well", consists of multiple features, including demonstrations of the rehabilitation exercises, daily notifications to remind and encourage the execution of home-based rehabilitation, sections that highlighted the benefits of adhering rehabilitation programme. Three sets of growth mixture modeling following intent-to-treat principles, respectively for treatment motivation, rehabilitation adherence, and IKDC were conducted with Mplus 7.1[3]. Conventional cut off and class-solution criteria were adopted[4, 5]. The two classes specified patients who were either high or low in the initial status of the outcome variables.

Results: The growth model revealed that the two classes-solution was the most appropriate in all three variables. For the intervention effects, there was significant decline for the treatment motivation in the two classes of control group (M_{slope} = -.39 to -.12, $p < .01$) but not in the intervention group (M_{slope} = -.10 to -.08, $p > .05$). As expected, the two latent classes in control group had significant drop in adherence (M_{slope} = -.25 to -.15, $p < .01$). In intervention group, the class with high initial status in adherence also decreased (M_{slope} = -.50, $p < .01$). However, there was no significant decline in the class with low initial status of rehabilitation adherence in the baseline (M_{slope} = .04, $p > .05$). The IKDC scores were consistent in intervention and control group.

Discussion and Conclusion: The current study supported that our mHealth intervention was effective in maintaining patients' self-determined treatment motivation and rehabilitation adherence for patients who had lower initial rehabilitation adherence. However, the proposed intervention effects on IKDC were not statistically significant. Overall, the current study provides empirical evidence on using mHealth intervention to facilitate rehabilitation adherence and the application can be extended to different medical aspects, including cardiac rehabilitation[6] and psychological disorder treatment[7].

Reference:

1. Deci, E.L. and R.M. Ryan, *Self-determination theory: A macrotheory of human motivation, development, and health.* Canadian psychology, 2008. **49**(3): p. 182.

2. Huang, C.-C., et al., *Comparing the Chinese versions of two knee-specific questionnaires (IKDC and KOOS): reliability, validity, and responsiveness.* Health and quality of life outcomes, 2017. **15**(1): p. 238.

3. Muthén, L. and B. Muthén, *Mplus.* The comprehensive modelling program for applied researchers: user's guide, 2015. **5**.

4. Hu, L.t. and P.M. Bentler, *Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives.* Structural equation modeling: a multidisciplinary journal, 1999. **6**(1): p. 1-55.

5. Nylund, K.L., T. Asparouhov, and B.O. Muthén, *Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study.* Structural equation modeling: A multidisciplinary Journal, 2007. **14**(4): p. 535-569.

6. Dohnke, B., E. Nowossadeck, and W. Müller-Fahrnow, *Motivation and participation in a phase III cardiac rehabilitation programme: an application of the health action process approach.* Research in sports medicine, 2010. **18**(4): p. 219-235.

7. Tedstone, J.E. and N. Tarrier, *Posttraumatic stress disorder following medical illness and treatment.* Clinical psychology review, 2003. **23**(3): p. 409-448.

Evaluation of Mindfulness-Based Intervention on Enhancing Shooting Performance in Elite Air Pistol Shooters

Lo Ka Kay[1,2], *Chung Wai Yee*[2]
[1]Hong Kong Sports Institute; [2]Department of Health and Physical Education, The Education University of Hong Kong

(a) **Objectives**: Mindfulness-Based Intervention (MBI) in sports has been increasing trend to be viewed as a trainable psychological skill for sports performance enhancement by improving concentration and reducing anxiety, heightening self-awareness, and reducing the frequency of negative thoughts. (Bernier et al., 2009; Gardner & Moore, 2007). This study aimed to evaluate impact in shooting performance of a 12-week MBI program on elite shooters and assessed changes in dispositional mindfulness and underlying facet, while exploring related changes in Heart Rate Variability (HRV), an indicator of the autonomic nervous system's ability to adjust physiological arousal to adapt to the demands of the stressful situation. (Appelhans and Luecken, 2006; Wheat and Larkin 2010).

(b) **Methods:** Five elite shooters participated in this study and received mindfulness meditation for sports program (MMTS 2.0) (Baltzell & Summers, 2018) for 12 weeks. Informed consent, demographic information was gathered at baseline. All participants completed Five Facet Mindfulness Questionnaire (FFMQ) (Deng, Y. Q., et al., 2011), HRV measurement with HRV indices of time domain (RMSSD) and frequency domain (HF, LF, LF/HF), and shooting performance tests on baseline and after 12-week MMTS 2.0 mindfulness training program. Wilcoxon signed-rank test was used for all comparisons between baseline and post-test.

(c) **Results:** Shooting performance improved significantly from baseline to post-test (P = 0.043). There was a significant difference in the mean difference score improvements from FFMQ in the underlying facets of 'Describing' (P = 0.026), 'Acting with Awareness' (P = 0.046) and 'Non-Judging Inner Experience, (P = 0.026), but no significant difference in 'Observing' (P = 0.141) and 'Non-reactivity to inner experience' (P = 0.141), A significant increase in HF (P = 0.046) and LF/HF ratio (P = 0.046), decrease in LF (P = 0.046), but no significant difference on RMSSD (P = 0.593) from baseline to post-test.

(d) **Discussion and Conclusion:** The findings suggest that a 12-week MMTS 2.0 be an effective intervention to enhance mindfulness, with the increase of the parasympathetic system to adjust physiological arousal to adapt to the demands of the stressful situation for enhancing shooting performance. Coaches may consider to use the non-invasive tool, HRV measurement to pre-screen athlete emotional state during training and competition. Athletes might become aware of their ability to alter their autonomic nervous systems, which may lead to a greater sense of control, thus reduce anxiety. It is recommended a larger scale of research study with more participants is recommended for future studies.

(e) Reference

Baltzell, A., & Summers, J. (2018). The Power of Mindfulness: Mindfulness Meditation Training in Sport (MMTS). Springer.

Bernier, M., Thienot, E., Codron, R., & Fournier, J.F. (2009). Mindfulness and acceptance approaches in sport performance. Journal of Clinical Sport Psychology, 4, 320-333.

Deng, Y. Q., Liu, X. H., Rodriguez, M. A., & Xia, C. Y. (2011). The Five Facet Mindfulness Que stionnaire: Psychometric Properties of the Chinese Version. Mindfulness, 1-6. 2

Gardner, F. L., & Moore, Z. E. (2007). The psychology of human performance: The mindfulness acceptance-commitment approach. New York, NY: Springer Publishing. Weinberg, R. S. & Gould, D. (2003). Foundations of sport & exercise psychology (3rd ed.). Champaign, IL: Human Kinetics.

Appelhans, B. M., & Luecken, L. J. (2006). Heart rate variability as an index of regulated emotional responding. Review of General Psychology, 10(3), 229–240.

Wheat, A. L., & Larkin, K. T. (2010). Biofeedback of heart rate variability and related physiology: A critical review. Applied Psychophysiology and Biofeedback, 35, 229–242.

The Influence of Psychological Factors in Patients with Rotator Cuff Tendinopathy: A Systematic Review

Wai-Keung WONG[1], *Ming Yan LI*[1], *Patrick Shu-hang YUNG*[1], *Hio Teng LEONG*[1]
[1]Department of Orthopaedics & Traumatology, Faculty of Medicine, The Chinese University of Hong Kong

Objectives:
Psychological elements play a vital role in the recovery of individuals with rotator cuff tendinopathy. Yet, the associations between psychological factors and rotator cuff tendinopathy are still under investigation. The purpose of this systematic review is to (1) summarize the psychological factors that may be related to rotator cuff tendinopathy; and (2) determine if these psychological factors may affect the patients reported outcomes including pain, function and quality of life.

Methods:
Studies reporting the psychological factors associated with rotator cuff tendinopathy and patients reported outcomes were searched with appropriate keywords via EMBASE, MEDLINE/ PUBMED, CINAHL, Web of Science from inception to September 2018. Search results were further reviewed to yield relevant clinical studies according to the inclusion criteria, and two reviewers assessed the methodological quality using the New-castle Ottawa Quality Assessment Scale (NOMAS) independently.

Results:
Of 1628 relevant studies, nine were included in the final analysis. Moderate evidence suggests that depression, anxiety and sleep disturbance were associated with rotator cuff tendinopathy. Moderate evidence showed that depression, anxiety, distress, fear of pain, pain catastrophizing, expectation, emotion and mental health were associated with pain in patients with rotator cuff tendinopathy. Moderate evidence showed that depression, anxiety, distress, expectation and mental health were associated with functional abilities in patients with rotator cuff tendinopathy. Moderate evidence showed that depression, anxiety and expectation were associated with quality of life (QoL) in patients with rotator cuff tendinopathy.

Discussion and Conclusion:
Based on the present evidence, depression, anxiety and sleep disturbance were associated with rotator cuff tendinopathy, and various psychological factors may affect patient-reported outcomes in patients with rotator cuff tendinopathy. In the clinical practice, biopsychosocial interventions with cognitive-behavioural strategies and education may be incorporated in the management for rotator cuff tendinopathy and these warrant further investigations.

Reference

Alizadehkhaiyat, O., Roebuck, M.M., Makki, A.T. & Frostick, S.P. (2017). Pain, functional disability, psychological status, and health-related quality of life in patients with subacromial impingement syndrome. *Cogent Medicine.* 4:1406631.

Barlow, J. D., et al. (2016). "What factors are predictors of emotional health in patients with full-thickness rotator cuff tears?" *J Shoulder Elbow Surg* 25(11): 1769-1773.

Cho, C., Seo, H., Bae, K., Lee, K., Hwang, I., & Warner, J. J. P. (2013). The impact of depression and anxiety on self-assessed pain, disability, and quality of life in patients scheduled for rotator cuff repair. *Journal of Shoulder and Elbow Surgery*, 22(9), 1160-1166.

Cho, C., Song, K., Hwang, I., & Warner, J. (2015). Does rotator cuff repair improve psychologic status and quality of life in patients with rotator cuff tear? *Clinical Orthopaedics and Related Research®*, 473(11), 3494-3500.

George, S. Z., & Hirsh, A. T. (2009). Psychologic influence on experimental pain sensitivity and clinical pain intensity for patients with shoulder pain. *Journal of Pain*, 10(3), 293-299.

Lewis, J., McCreesh, K., Roy, J.S. & Ginn, K. (2015). Rotator cuff tendinopathy: navigating the diagnosis-management conundrum. *Journal of Orthopaedic & Sports Physical Therapy*, 45(11), 923-937.

Piitulainen, K., Ylinen, J., Kautiainen, H. & Hakkinen, A. (2012). The relationship between functional disability and health-related quality of life in patients with a rotator cuff tear. *Disabil Rehabil*.34:2071–2075.

Potter, M., Wylie, J., Greis, P., Burks, R., & Tashjian, R. (2014). Psychological distress negatively affects self-assessment of shoulder function in patients with rotator cuff tears. *Clinical Orthopaedics and Related Research®*, 472(12), 3926-3932.

Tashjian, R.Z., Henn, R.F., Kang, L. & Green, A.(2004). The effect of comorbidity on self-assessed function in patients with a chronic rotator cuff tear. *J Bone Joint Surg Am.* 86:355–362.

Winters, J.C., Sobel, J.S., Groenier, K.H., Arendzen, J.H. & Meyboom-de Jong, B. (1993). The long-term course of shoulder complaints: a prospective study in general practice. *Rheumatology (Oxford)*, 38(2), 160-3.

Identification of Senior Primary School Students with Potential Mood Problems Using Video-Based Gait Analysis

Alan Kwong-Yik Lok[1], *Nathan Kwan-Nok Cheung*[1], *Johnny Chun-Hei Ho*[1], *Sharon Cheuk-Yan Poon*[1], *Jack Cheuk-Lam Tang*[1], *Peter Pak-Kwan Chan*[1], *Meizhen Huang*[1], *Roy Tsz-Hei Cheung*[1]
[1]Gait & Motion Analysis Laboratory, Department of Rehabilitation Sciences, The Hong Kong Polytechnic University

Objectives

Suicide rate of school-aged adolescents in Hong Kong has increased 70% from 2015 to 2017 (1). Unfortunately, each primary school is only allowed to hire one single social worker to manage 800-1,200 students (2). Thus, identification of individuals with potential mood problem has become a challenge to frontline school social workers. Previous studies reported that specific gait kinematics was associated with sadness and depression. Reduced walking speed, arm swing, vertical head movements and increased slump posture were identified kinematic markers in a depression gait (3,4). However, participants in these studies were limited to adults, who presented different walking biomechanics when compared with children (5). Novel technology has been launched to analyze multi-person pose detection using RGB video analysis (6), suggesting a viable approach to detect gait patterns in a school environment. Hence, this study aimed to identify gait parameters associated with potential mood problem (PMP) among senior primary school students by video analysis, as a foundation for developing an assistive tool to screen out students with PMP.

Methods

A total of 62 senior primary school students (i.e. P.4 to P.6) were recruited from three local schools. All participants were asked to complete a set of DASS-21 questionnaire (7). Each participant also performed an overground walking trial on a 10-m walkway with his/her usual gait pattern for 3 minutes (8). RGB video of each walking trial was recorded by video camera set up at the side of the walkway, for capturing the full body movement of the participant in the sagittal plane.

Participants who scored > 8 in the depression domain (9) in the DASS-21 scale were classified as PMP group (n=31, age: 10.6±1.0 years, height: 1.44±0.08 m, weight: 38.9±10.2 kg, gender: 19 males; 12 females). Participants who scored < 2 in the DASS-21 questionnaire were identified as control group (n=31, age: 10.6±0.7 years, height: 1.43±0.11 m, weight: 40.3±15.0 kg, gender: 9 males; 22 females).

RGB videos of the selected participants were processed by a human pose detection algorithm (6). For each selected video, anatomical landmarks' trajectories of the participant during walking were extracted. Based on the trajectories, gait parameters were computed using a customized MATLAB script. Variables of interest included walking speed (3, 10), stride length (10), duration of gait cycle (10), arm swing velocity and amplitude (3, 11), duration of arm swing cycle, amplitude of vertical head movement (3), neck flexion angle (3), thorax lumbar angle and hand posture during walking.

We compared selected gait parameters between PMP and control groups using independent t-test. Cohen's d was calculated to indicate the effect size.

Results

The DASS score in the PMP group was higher than the Control group (p<**0.001**). The number of male subjects in the control group was significantly fewer than the PMP group (p=**0.011**). Otherwise, the two groups were matched in terms of demographics.

Participants in the PMP and Control groups walked at a similar gait speed (p=0.828). However, participants in the PMP group exhibited a greater degree of neck flexion, when compared with the control group (p=0.046, Cohen's d=0.519). There were no differences in other selected gait parameters (p=0.127-0.885).

Discussion and Conclusion

We identified a kinematic marker i.e., neck flexion angle, to potentially differentiate senior primary school students with PMP. This finding aligned with a specific pattern observed in a depression gait (3). Our findings suggest a viable solution to enhance first line screening and shortlist students at risk.

References

1. The Coroner's court. Coroner's report Hong Kong, 2015, 2017.
2. Education Bureau. 2018.
3. Michalak J, Troje NF, et al. *Psychosomatic medicine,* 2009; *71*(5):580-587.
4. Sanders JB, Bremmer MA, et al. *J Am Geriatr Soc,* 2012; *60*(9):1673-1680.
5. Froehle A, Nahhas R, et al. *Gait & Postur*e, 2013; *38*(1): 14-19.
6. Cao Z, Hidalgo G, et al. *IEEE Trans Pattern Anal Mach Intell*, 2019; 1-1.
7. Osman A, Wong JL, et al. *J Clin Psychol*, 2012; *68*(12):1322-1338.
8. Roether CL, Omlor L, et al. *J Vis*, 2009; *9*(6):5-15.
9. Tran, TD, Tran T, et al. *BMC Psychiatry*, 2013; *13*(1): 24-24.
10. Lemke MR, Wendorff T, et al. *J Psychiatr Res,* 2000; *34*(4-5):277-283.
11. Omlor L, Giese MA. *Neurocomputing*, 2007; *70*(10-12):1938-1942.

The Effect of Brief Mindfulness Intervention as Adjuvant of Fluid Intake to Refuel Soccer Players during Half-time Break

Yuxin Zhu[1], *Fenghua Sun*[1], *Chunxiao Li*[2], *Hungkay Chow*[1]
[1]Department of Health and Physical Education, The Education University of Hong Kong
[2]Department of Physical Education and Sport Science, Nanyang Technological University

This study investigated the effect of combined nutrition intake and brief mindfulness intervention on athletes' fatigue recovery in simulative soccer competition. In a 3 (treatments) * 2 (timepoints) double blind cross-over design, fourteen male athletes (age: 24.3±3.7 yr, height: 173.8±4.5 cm, weight: 68.3±5.1 kg, VO2max: 47.0±4.4 ml/kg/min) received three treatments (Control: non-carbohydrate (CHO) solution + traveling introduction audio; CHO: CHO-electrolyte solution+ traveling introduction audio; and CHO_M: CHO-electrolyte solution + mindfulness based intervention (MBI)) during the simulative half-time break. Vertical jump and sprint performance were assessed immediately before and after the exercise. Mental fatigue, rating of perceived exertion (RPE) level and muscle pain were reported during and after the exercise. Mindfulness level was measured immediately after the audio or mindfulness intervention. Blood glucose and lactic were tested immediately before, during and after the exercise. Heart rate was recorded on a minute-by-minute basis in the audio duration of intervention. The major findings were: (1) MBI during the half-time-break significantly increased athlete's mindfulness level (Control vs. CHO vs. CHO_M: 2.11± 0.19 vs. 2.43± 0.27 vs. 5.32 ± 0.15, $p < 0.01$); (2) when compared with Control and CHO trials, participants in CHO_M trial showed more stable performance (Interclass correlation, 0.95 vs. 0.98 vs. 0.99, $p < 0.01$); (3) participants in CHO_M trial performed slightly better in the repeated sprint tests than CHO trial (CHO vs. CHO_M: 0.13± 0.18 vs. 0.06 ± 0.13, $p < 0.01$). In conclusion, MBI seems to be beneficial to athletes' recovery from fatigue in the early stage of second half.