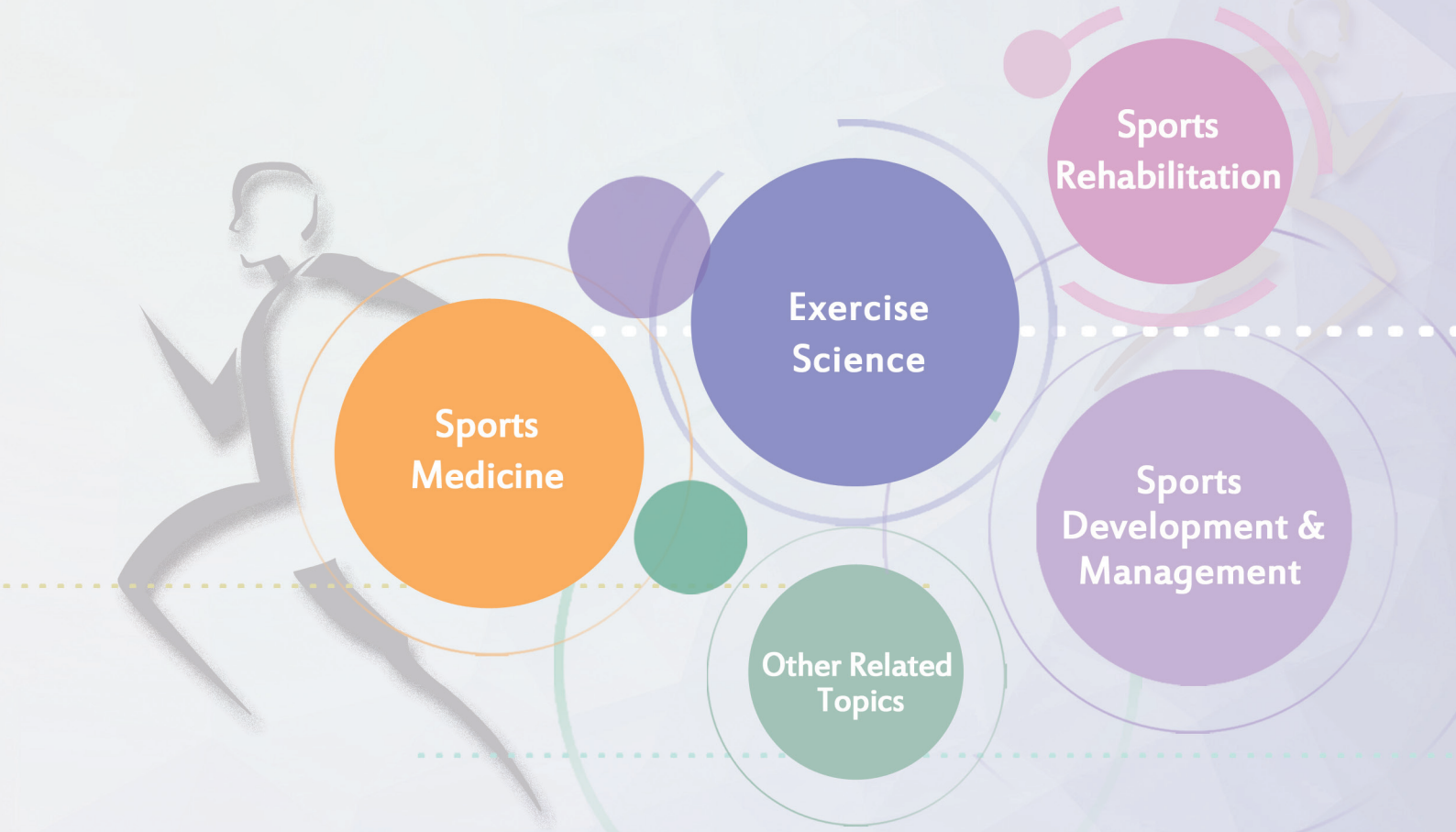
5th HKASMSS Student Conference on Sports Medicine, Rehabilitation & Exercise Science 2016

Health and Life Quality Enhancement through Application of Science

Program Book



Venue: Hong Kong Sports Institute
Date: 26 November 2016 (Sat)
Time: 9:00am – 6:15pm

Organizer:

Supporting Organization:

香港浸會大學 HONG KONG BAPTIST UNIVERSITY
香港教育大學 The Education University of Hong Kong
Department of Health and Physical Education
SCHOOL OF PUBLIC HEALTH THE UNIVERSITY OF HONG KONG 香港大學公共衞生學院

PROGRAM

Time	Program	Speaker
0830-0900	Registration	
	Free Paper Presentation I: Exercise Science (I)	*Moderator: Dr. Justin LEE*
0900-0915	Effects of Vitamin D Supplementation on Balance and Muscle Strength in Vitamin D Deficient Young Adults: A Pilot Study	Ms. Chung-yan CHAN (RS - PolyU)
0915-0930	The Effect of Topical Fish Oil and Therapeutic Ultrasound on Tendon Healing: A Histological Study in a Rat Model	Ms. Karly, Oi-wan CHAN (RS - PolyU)
0930-0945	A Novel Wear-Site for Accelerometers Use in Physical Activity Measurement	Ms. Joni, H. ZHANG (SPH - HKU)
0945-1000	Self-perceived Physical Literacy and Teaching Efficacy of Physical Education Teachers in Hong Kong	Mr. Benjamin, Bing-chung KWOK (SSPE - CUHK)
1000-1015	Validation of Electronic Activity Monitor Devices during Treadmill Walking	Ms. Ka-man TAM (PE - HKBU)
1015-1030	Opening Ceremony	
1030-1115	**<u>Keynote Lecture:</u> Developing Physical Literacy through Sport Education: Current Progress and Future Challenges**	**Prof. Tristan WALLHEAD** *Moderator: Prof. Raymond SUM*
1115-1130	**Open Discussion**	
1130-1200	Tea Break	
	Poster Presentation I	*Moderator: Prof. Kam-ming MOK & Dr. Justin LEE*
	Free Paper Presentation II: Sports Psychology and Behavior	*Moderator: Dr. Derwin CHAN*
1200-1215	Children with Physical Disabilities at School and Home: Physical Activity and Contextual Characteristics	Ms. Ru LI (SSPE - CUHK)
1215-1230	Systematic Review: The Psychological and Behavioural Factors of Unintentional Doping	Mr. Alfred LEE (SPH - HKU)
1230-1245	The Importance of Recreation Physical Activity in Promoting Physical Literacy among Hong Kong Adolescents	Mr. Siu-ming CHOI (SSPE - CUHK)
1245-1300	The Impacts of Increasing Physical Activity on Motor Functions, Behaviours, Activity Participation and Quality of Life of Children with Developmental Coordination Disorder	Ms. Yoyo, Ting-yiu CHENG (SPH - HKU)
1300-1315	Factors Influencing Physical Literacy of Adolescents – Experience on Developing a PPLI-A Instrument	Mr. Fong-jia WANG (SSPE - CUHK)

PROGRAM

Time	Program	Speaker
1315-1400	Lunch & Open Discussion of Poster Presentation	
1400-1430	**<u>Keynote Lecture:</u> ACL Injury Prevention: From Science to Sustainable Behavior Change**	**Prof. Erich PETUSHEK** *Moderator: Prof. Kam-ming MOK*
1430-1500	**Panel Discussion: How to Implement ACL Injury Prevention Program in The Community Effectively?**	*Panel: Prof. Patrick YUNG, Dr. Lobo LOUIE, Dr. Roy CHEUNG*
	Free Paper Presentation III: Exercise Science (II)	*Moderator: Prof. Kam-ming MOK*
1500-1515	Effect of Real-time Auditory Feedback on Impact Loading before and after Running Retraining	Mr. Ivan, Pui-hung AU (RS - PolyU)
1515-1530	Learning to Run: Consistency of Motor Modules among Experienced but Not Novice Runners	Mr. Ben, Man-fei CHEUNG (MBChB - CUHK)
1530-1545	Immediate and Short Term Effect of Running Shoes in Habitual Barefoot Runners	Ms. On-yue LAU (RS - PolyU)
1545-1600	The Pattern of Impact Acceleration during Distance Running	Mr. Shi-wei MO (HPE - EdUHK)
1600-1615	Kinetics Control in Runners at Different Running Speeds and Slopes After Completion of a Gait Retraining Program	Ms. Janet, Han-wen ZHANG (RS - PolyU)
1615-1645	Tea Break	
	Poster Presentation II	*Moderator: Prof. Kam-ming MOK & Dr. Justin LEE*
	Free Paper Presentation IV: Sports Medicine and Rehabilitation	*Moderator: Dr. Roy CHEUNG*
1645-1700	Real Time Feedback Gait Retraining Improves Symptoms in Patients with Knee Osteoarthritis: A Randomized Controlled Trial	Mr. Ivan, Pui-hung AU (RS - PolyU)
1700-1715	Effect of Facilitatory Kinesio Tape on Muscle Activity and Performance in Regular Users and Non-users	Mr. Dominic, Ngo-tung MAK (MBChB - CUHK)
1715-1730	The Investigation of Biomechanical Properties of Tibial Anterior Muscle of People with Chronic Stroke	Ms. Mei-zhen HUANG (RS - PolyU)
1730-1745	Injury Patterns in Adolescent Male Football Players and Its Relationship to Sexual Maturity. A Cross-Sectional Study	Mr. Kwong-yan CHEUNG (O&T - CUHK)
1745-1800	Immediate Effects on the Changes of Morphological and Mechanical Properties of Achilles Tendon After Jogging or Race Walking	Mr. Ellis, Chun-fai LI (HTI - PolyU)
1800-1815	Closing Ceremony	

POSTER PRESENTATION I (Time slot: 1130-1200)

Concurrent Poster Presentations of Original Research and Project Proposal

No.	Original Research (4-min each)	Speaker
1-1	Comparison of Biomechanical Parameters Between Elite and Recreational Marathon Runners from Hong Kong and Africa	Ms. Janet, Han-wen ZHANG (RS - PolyU)
1-2	Biomechanical Analysis in Various Types of Push-Ups: Implication for Home-Based Upper Body Trainings	Ms. Christianne, On-nor Anna HO (SMHS - CUHK)
1-3	The Impact of Stroke on Bone Mass and Macrostructure Properties: A Systematic Review	Mr. Zhen-hui YANG (RS - PolyU)
1-4	Effect of Inhibitory Kinesio Tape on Measured vs. Perceived Maximum Grip Strength	Ms. Aislinn Joan Campbell MACPHAIL (RS - PolyU)
1-5	Associations of Physical Activity, Low Back Pain and Neck Pain in Hong Kong Adolescents	Ms. Hoi-yan MOK (SPH - HKU)

No.	Project Proposal (3-min each)	Speaker
2-01	Effects of a Visual-feedback Gait Retraining on Landing Pattern Transition in Rear-foot Strike Runners	Ms. Zoe, Yau-shan CHAN (RS - PolyU)
2-02	Alterations in Patellofemoral Kinematics Following Anterior Cruciate Ligament Deficiency and Reconstruction	Dr. Wen-han HUANG (O&T - CUHK)
2-03	Physical Literacy: A Survey of Hong Kong Universities Students	Ms. Suet-ting LAM (SSPE - CUHK)
2-04	Investigation of the Gaze Behavior During Walking in Community-dwelling Elderly People: Implication for Fall Rehabilitation	Mr. Toby, Chi-to MAK (SPH - HKU)
2-05	Effects of Multi-directional Visual Signals on Running Biomechanics	Ms. Anamaria Laudet MANGUBAT (RS - PolyU)
2-06	Correlation between Tasks and Stability of Knee, and Performances within Multiple Types of Tasks	Mr. Tsz-ki NG (EE - CUHK)
2-07	Biomechanical Difference in Forward Lunges and Lateral Lunges and Changes in Knee Joint Moment and Functional Measurement	Mr. Ming-chung POON (SMHS - CUHK)
2-08	Compare the Validity of Movement Tasks for Analysis of Function of Anterior Cruciate Ligament Using Portable System	Mr. Long-ho WONG (EE - CUHK)
2-09	The Association of Physical Activity and Physical Literacy of Schools Principals among Cross-Strait Four Regions	Ms. Po-ling WONG (SSPE - CUHK)
2-10	The Acute Effect of Self-Myofascial Release, Dynamic Stretching and Combination of Self-Myofascial Release and Dynamic Stretching on Lower Limb Muscle Flexibility and Performance	Ms. Ying-ying CHAN (SMHS - CUHK)

POSTER PRESENTATION II (Time slot: 1615-1645)

Concurrent Poster Presentations of Original Research and Project Proposal

No.	Original Research (4-min each)	Speaker
1-6	The Effect of Aerobic Exercise Combined with Garcinia Cambogia Extract on the Body fat and Blood Lipids in Rats	Ms. Zheng ZHANG (SPH - HKU)
1-7	Effects of Deceptive Footwear Condition on Subjective Comfort and Joint Kinematics in Runners	Ms. Zoe, Yau-shan CHAN (RS - PolyU)
1-8	A Comparison of Muscle Coordination and Stroke Kinematics between Stationary and Dynamic Indoor Rowing Machines in Lightweight Rowers	Mr. Ming-hang CHEUNG (SSPE - CUHK)
1-9	Water-based and Land-based Recovery Exercise on Circulatory Response and Muscle Injury after Prolonged Eccentric Exercise	Mr. Edwin, Chun-yip CHIN (HPE - EdUHK)

No.	Project Proposal (3-min each)	Speaker
2-11	The Use of Thermosensitive mPEG-polyalanine Hydrogel to Localize Platelet-Rich Plasma for Intra-tendinous Injection	Ms. Yuan-dong JIANG (SMHS - CUHK)
2-12	Sports Injury in University Athletes in Hong Kong	Ms. Wai-ling LEUNG (SMHS - CUHK)
2-13	Development of an Anti-Ankle Sprain Shoe that Prevents Ankle Inversion through Myoelectric Stimulation	Ms. Sze-man WONG (EE - CUHK)
2-14	An Investigation of the Effect of Platelet-rich Fibrin (PRF) to Treat Anterior Cruciate Ligament(ACL) Partial Tear in a Rat Model	Mr. Shao-qi ZHANG (SMHS - CUHK)
2-15	Design for the EMG-Driven Cable-Robot Exoskeleton for Shoulder Rehabilitation Devices	Mr. Hung-hon CHENG (MAE - CUHK)
2-16	How Effective of Lower Limb Resistance Training to Elder Chinese in Pre-Sarcopenia and Sarcopenia Stage	Ms. Li-juan LU (SMHS - CUHK)
2-17	The Effects of Current Virtual and Augmented Reality Technology on Walking Biomechanics	Ms. Aislinn Joan Campbell MACPHAIL (RS - PolyU)
2-18	Physical Literacy and Coaching: Comparing Coaches' and Student-athletes' Perceptions of Physical Literacy in Hong Kong Secondary Schools	Ms. Ming-hui LI (SSPE - CUHK)
2-19	Intention-driven Shoulder Rehabilitation for Targeted Neuro-muscular Training Using an Exo-musculoskeletal Robot	Ms. Hang-man YIP (EE - CUHK)

CUHK	EE	Department of Electronic Engineering, The Chinese University of Hong Kong
	MAE	Department of Mechanical and Automation Engineering, The Chinese University of Hong Kong
	MBChB	Faculty of Medicine, The Chinese University of Hong Kong
	O&T	Department of Orthopedics and Traumatology, The Chinese University of Hong Kong
	SMHS	Sports Medicine and Health Science, Department of O&T, The Chinese University of Hong Kong
	SSPE	Department of Sports Science and Physical Education, The Chinese University of Hong Kong
EdUHK	HPE	Department of Health and Physical Education, The Education University of Hong Kong
HKBU	PE	Department of Physical Education, Hong Kong Baptist University
HKU	SPH	School of Public Health, The University Of Hong Kong
PolyU	HTI	Department of Health Technology and Informatics, The Hong Kong Polytechnic University
	RS	Department of Rehabilitation Sciences, The Hong Kong Polytechnic University

CONTENTS

Message from the President

Hong Kong Association of Sports Medicine and Sports Science

The Hong Kong Association of Sports Medicine and Sports Science was established in 1988 and our objective is to promote and advance the practice, education and research of medicine and science in relation to sports and exercise. This is the fifth Student Conference on Sport Medicine, Rehabilitation and Exercise Science organized by our association and partner academic institutions. This rise in importance of weight management and physical fitness becomes a concern for today's people. "Health and Life Quality Enhancement through Application of Science" was chosen as this year's theme and I hope the conference would offer a knowledge exchange platform for our young researchers in this field.

Moreover, special thanks should be given to Prof. Patrick Yung and his team from the Department of Orthopedics and Traumatology, The Chinese University of Hong Kong for hosting this year's conference.

I hope each participant will fully embrace this opportunity to share and look forward to every success in the event.

Best Regards,

Dr. Lobo LOUIE
President,
Hong Kong Association of Sports Medicine and Sports Science

Message from the Immediate Past President

Hong Kong Association of Sports Medicine and Sports Science

I am delighted to welcome you to the "5th HKASMSS Student Conference on Sports Medicine, Rehabilitation and Exercise Science 2016" to be held at Hong Kong Sports Institute (HKSI), on 26 November 2016.

This year we are most grateful to have Prof. Patrick Yung from the Department of Orthopaedics and Traumatology, Faculty of Medicine, The Chinese University of Hong Kong to host this very important event.

The theme of this year is "Health and Life Quality Enhancement through Application of Science", it would provide an excellent opportunity for our students to present their research works, discuss issues with fellow students and to meet new colleagues from different groups in local institutes working in sports related research.

We are confident that all participants will find this conference rewarding and fruitful.

Best Regards,

Dr. Gary MAK
Immediate Past President,
Hong Kong Association of Sports Medicine and Sports Science

Message from the Conference Chairman

5th HKASMSS Student Conference on Sports Medicine, Rehabilitation and Exercise Science

It is my pleasure to invite you to participate in the 5th HKASMSS Student Conference on Sports Medicine, Rehabilitation and Exercise Science, featuring "Health and Life Quality Enhancement through Application of Science". The Department of Orthopedics and Traumatology, The Chinese University of Hong Kong is honored to host this conference.

The previous HKASMSS Student Conference on Sports Medicine, Rehabilitation and Exercise Science were great successful stories and clearly highlighted the depth of academic talent and research ability of our local students in the field of sports medicine and sports science.

This year, the conference is poised for its next level of perfection and continues to serve as a platform for postgraduate and undergraduate students to share their research ideas, to gain experience in delivering presentation, as well as to gain exposure to the local community in sports. It will also be a valuable learning experience that stimulates them for future presentations in international conference.

I am sure our fellow Hong Kong students will enjoy the conference and meet friends!

Best Regards,

Prof. Patrick YUNG
Chairman of Organizing Committee,
The 5th HKASMSS Student Conference on Sports Medicine, Rehabilitation and Exercise Science 2016

Message from the Conference Vice-chairman

5th HKASMSS Student Conference on Sports Medicine, Rehabilitation and Exercise Science

On behalf of the Department of Sports Science and Physical Education, I would like to warmly welcome you to the 5th HKASMSS Student Conference on Sports Medicine, Rehabilitation and Exercise Science 2016 at the Hong Kong Sports Institute. The theme of this conference is “Health and Life Quality Enhancement through Application of Science”. The program of this conference is an impressive collection of topics ranging from medical science and social science in sports, exercise and physical activity. Apart from two keynote lectures, I am also delighted to invite all participants to attend all oral presentation sessions as well as poster sessions since these sessions give students a platform to exchange research ideas, explore collaboration opportunities, meet new friends and enrich their knowledge.

I sincerely look forward to continuing a stronger collaborative partnership in advancing sports, exercise science and physical activity agenda.

Enjoy,

Prof. Raymond Kim-wai SUM
Vice-chairman of Organizing Committee,
The 5th HKASMSS Student Conference on Sports Medicine, Rehabilitation and Exercise Science 2016

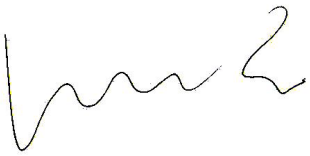
Message from the Co-organizer

Hong Kong Sports Institute

Welcome to the Hong Kong Sports Institute! It is with great joy that we welcome you to the 5th HKASMSS Student Conference on Sports Medicine, Rehabilitation and Exercise Science 2016. Hong Kong Sports Institute is honored to co-organize this meaningful event. Student conference is an important platform for students to exchange ideas and gain new inspirations. This year, the theme is “Health and Life Quality Enhancement through Application of Science”. I wish the participants would make full use of this wonderful opportunity to translate their research finding to a practical application.

I wish all participants will experience an amazing conference at the Hong Kong Sports Institute!

Best Regards,



Dr. Raymond SO
Director, Elite Training Science & Technology Division,
Hong Kong Sports Institute

Keynote Speakers

Developing Physical Literacy through Sport Education: Current Progress and Future Challenges

Prof. Tristan WALLHEAD
Associate Professor,
Division of Kinesiology and Health, College of Health Sciences,
The University of Wyoming, Wyoming, USA

Prof. Tristan WALLHEAD completed his PhD at The Ohio State University in 2004. Since then he has been a faculty member in the Physical Education Teacher Education (PHET) program at the University of Wyoming. He has published over 30 peer-reviewed manuscripts on the effects of Sport Education on student motivation for physical literacy/physical activity, and uses the didactic methodology to examine student learning during peer-assisted learning strategies. He was promoted to Associate professor in 2010 and was inducted as a research fellow for AAHPERD in 2013. He recently received the Central District SHAPE Scholar Award (2016) and serves as an Associate Editor for the Journal of Teaching Physical Education.

ACL Injury Prevention: From Science to Sustainable Behavior Change

Prof. Erich PETUSHEK
Assistant Professor, College of Human Medicine,
Michigan State University, Michigan, USA

Prof. Erich PETUSHEK is an Assistant Professor in the College of Human Medicine at Michigan State University and Research Associate at Northern Michigan University. Prof. Petushek completed his Ph.D. in Applied Cognitive Science and Human Factors at Michigan Technological University, as a National Science Foundation (NSF) Graduate Research Fellow and recipient of an NSF GROW fellowship for international collaboration (Oslo, Norway). He completed his postdoctoral training at the University of Huddersfield (UK) in the Applied Cognition & Cognitive Engineering Research Group in collaboration with the English Institute of Sport. His research specializations are in applied expertise, psychological measurement, biomechanics, musculoskeletal injury prevention, and qualitative movement analysis/judgment. He is founder and lead scientist on the computerized injury prediction skill assessment and outreach project (www.ACL-IQ.org).

Original Research

Oral Presentation

Effects of Vitamin D Supplementation on Balance and Muscle Strength in Vitamin D Deficient Young Adults: A Pilot Study

Chung-yan CHAN[1], *Marco Y.C. PANG*[1], *Iris F. F. BENZIE*[2]
[1]Department of Rehabilitation Sciences, The Hong Kong Polytechnic University
[2]Department of Health Technology and Informatics, The Hong Kong Polytechnic University

Objectives:
Vitamin D is crucial in maintaining musculoskeletal health, which is an important determinant of physical performance. Balance and strength are two key domains of physical performance that have substantial impact on daily living. This pilot study aimed to investigate the effect of 3-month vitamin D supplementation on balance and strength of a group of vitamin D deficient young adults.

Methods:
A total of 22 vitamin D deficient young adults (serum 25(OH) D<50nmol/L) were randomly assigned into a vitamin D supplement group (2400IU per day) (n=11) or a placebo group (n=11). Outcome assessments were conducted at baseline and 3-month follow-up, which included the measurement of serum 25(OH)D level, balance (Motor Control Test: postural reaction latencies in response to platform forward and backward translations of different magnitudes), strength of the knee extensors and hand grip (hand-held dynamometry) were evaluated.

Results:
Twenty subjects completed the study. Six subjects of the placebo group received vitamin D supplementation after 3-month follow-up. Serum 25(OH)D were significantly increased in the supplement group when compared to the placebo group after the treatment period ($p<0.001$). Between-group comparison revealed the change in latency was significantly different between the two groups when large-amplitude forward translations were applied ($p=0.003$). Post-hoc analysis revealed that the supplement group did not show any significant change in postural reaction latencies while the placebo group demonstrated a significant increase in postural reaction latency when large-amplitude backward and forward platform translations were applied ($p=0.010$). Analysis of knee extensor and hand grip strength data revealed no significant group by time interaction effect.

Conclusion:
Vitamin D supplementation may play a role in maintaining the integrity of balance function. Yet, it may not have beneficial effect on muscle strength of vitamin D deficient young adults.

Reference:
[1] Holick M, Binkley N, Bischoff-Ferrari H, Gordon C, Hanley D, Heaney R et al. Evaluation, Treatment, and Prevention of Vitamin D Deficiency: an Endocrine Society Clinical Practice Guideline. The Journal of Clinical Endocrinology & Metabolism. 2011;96(7):1911-1930.
[2] Close G, Leckey J, Patterson M, Bradley W, Owens D, Fraser W et al. The effects of vitamin D3supplementation on serum total 25[OH]D concentration and physical performance: a randomised dose–response study. British Journal of Sports Medicine. 2013;47(11):692-696.
[3] Fitzgerald J, Peterson B, Warpeha J, Johnson S, Ingraham S. Association Between Vitamin D Status and Maximal-Intensity Exercise Performance in Junior and Collegiate Hockey Players. Journal of Strength and Conditioning Research. 2015;29(9):2513-2521.
[4] Scholten S, Sergeev I, Birger C, Song Q. Effects of vitamin D and quercetin, alone and in combination, on cardiorespiratory fitness and muscle function in physically active male adults. OAJSM. 2015;6:229-239.
[5] Wyon M, Koutedakis Y, Wolman R, Nevill A, Allen N. The influence of winter vitamin D supplementation on muscle function and injury occurrence in elite ballet dancers: A controlled study. Journal of Science and Medicine in Sport. 2014;17(1):8-12.

The Effect of Topical Fish Oil and Therapeutic Ultrasound on Tendon Healing: A Histological Study in A Rat Model

Karly Oi-wan CHAN[1], *Henry Hoi-yee TONG*[2], *Gabriel Yin-fat NG*[1]
[1] Department of Rehabilitation Sciences, The Hong Kong Polytechnic University, Hong Kong SAR, China
[2]School of Health Sciences, Macao Polytechnic Institute, Macau SAR, China.

Background:
Fish oil is rich in omega-3 polyunsaturated fatty acids (n3 PUFAs) especially eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) (Cleland, et al. 2006). N3 PUFAs have been reported to modulate inflammation and promote collagen synthesis *in vitro* (Hankenson, et al. 2000, Jia and Turek 2004). Our previous study showed that combining topical fish oil and therapeutic ultrasound treatment could augment the tensile strength and stiffness of repairing tendon (Chan, et al. 2016).

Objectives:
The aim of this study was to test the hypothesis that the improvement of healing for partially ruptured Achilles tendon treated by therapeutic ultrasound coupled with topical fish oil was due to better extracellular matrix organization.

Methods:
Thirty–six rats were randomly assigned to either control (CON), topical fish oil (FO), therapeutic ultrasound (US) or Combined fish oil and ultrasound (FU) group. All rats were treated daily for either 2 or 4 weeks. At the end of the treatment period, the animals were sacrificed. The harvested sections were examined histologically using hematoxylin and eosin (H&E) and Picrosirius red (PSR) stain. Quantitative analysis of the stained sections was performed by two blind assessors with ImageJ software. Cell counts and cell density were analysed for the H&E stained sections. The percentage of mature (red orange) collagen and immature collagen (yellow green) relative to total collagen were obtained from the PSR stained sections. Two-way ANOVA was performed to compare between groups and treatment duration. Fisher's least significant difference (LSD) post-hoc comparisons were conducted for significant ANOVA. Alpha was set at 0.05 for all statistical comparisons.

Results:
All the injured tendons displayed densely distributed fibroblasts particularly at 2 weeks. The 4-wk groups tend to have fewer cell count, more matrix and more regular tissue organization. FU at 4 weeks had fewer fibroblast counts ($p=0.0616$) while the fibroblasts in US at this time point appeared to occupy a smaller area ($p=0.0831$).

More slim, faint yellow green wires were detectable at the repair site in the injured tendons at 2 weeks which indicated a more active healing process. FU and FO showed significantly more mature collagen fiber and lower immature collagen fiber ($p<0.05$) at 4 weeks.

Conclusion :
The combination treatment of fish oil and ultrasound tended to enhance extracellular matrix organization and collagen synthesis at a greater extent than the US and FO group.

Reference:
[1] Chan KO, Tong HH, Ng GY. Topical Fish Oil Application Coupling with Therapeutic Ultrasound Improves Tendon Healing. Ultrasound Med. Biol. 2016.

[2] Cleland L, James M, Proudman S. Fish oil: what the prescriber needs to know. Arthrit. Res. Ther. 2006; 8:202.
[3] Hankenson KD, Watkins BA, Schoenlein IA, Allen KGD, Turek JJ. Omega-3 Fatty Acids Enhance Ligament Fibroblast Collagen Formation in Association with Changes in Interleukin-6 Production. Proc. Soc. Exp. Biol. Med. 2000; 223:88-95.
[4] Jia Y, Turek JJ. Polyenoic Fatty Acid Ratios Alter Fibroblast Collagen Production Via PGE2 and PGE Receptor Subtype Response. Exp. Biol. Med. 2004; 229:676-83.

A Novel Wear-Site for Accelerometers Use in Physical Activity Measurement

Joni ZHANG[1],Duncan MACFARLANE[1]
[1]School of Public Health, Li Ka Shing Faculty of Medicine, The University of Hong Kong, Pokfulam, Hong Kong

Background:
Accelerometry and other activity monitor technologies are important tools for measuring physical activity. However, participant compliance was commonly found to be a major limitation in many studies due to discomfort caused by wear-site requirements (e.g. the waist) that ensure the accuracy of the device. One of the most commonly used accelerometer brands is that of ActiGraph, the default Actigraph accelerometer position has traditionally been on the Waist due to its close proximity to the center of mass (CoM), but often results in low participant compliance (often <50%). The Wrist-site was adopted and effectively increased participant compliance but ultimately compromises measurement as it is quite remote from the CoM. Thus, a new favorable wear-site with comparable accuracy is needed to overcome these challenges. To date, majority of accelerometer wear-position comparison studies focused on comparing different positions around the waist (e.g. Lower back, right/left Hip) and wrist (dominant v. non dominant). Surprisingly, only few studies have examined Chest-mounted accelerometer accuracy for the purpose of posture recognition and fall detection, and almost no studies have examined the validity of a Chest-mounted accelerometer in physical activity measurement.

Objectives:
To determine if our new accelerometer wear-site (worn like a necklace at chest level, underneath clothing) can provide measurements significantly superior to the Wrist, yet has high compliance and provides results more comparable to the Waist.

Methods:
A convenience sample of forty-five healthy young adults (23 male) wore accelerometers simultaneously at their Waist, Wrist, and Chest during a series of slow (2.4-3.2kph), average (4.0-6.4kph) and fast (7.2-8.0kph) walking speeds on a treadmill. Correlations and absolute percentage errors of the vector magnitude counts were computed between each measurement site. Bland-Altman plots were generated to graphically illustrate the variability of the errors.

Results:
The Wrist-site overestimated VM to a greater extent at all speeds in comparison to the Chest. Pearson's r correlations were weaker for Waist–Wrist (<.80) in comparison to the Waist–Chest (>.85). The APE's were much lower (i.e. higher agreement) for the Chest (9.23-15.5%) compared to the Wrist (19.7-54.9%). Participants also felt the Chest-site was more acceptable than the Waist-site.

Conclusion:
This new Chest site provides data that is superior than the Wrist, whilst being very comparable, but with higher acceptability, to the Waist. Our new Chest site using a necklace provides preliminary data to suggest it can be considered as an alternative wear-site for those participants who predominantly walk.

Self-perceived Physical Literacy and Teaching Efficacy of Physical Education Teachers in Hong Kong

Benjamin KWOK, Raymond Kim-wai SUM
Department of Sports Science and Physical Education, The Chinese University of Hong Kong

Objectives:
Physical literacy is becoming an increasingly important part of a physical education curriculum, and physical education teachers (PE teachers) have a crucial role in developing physically literate students. In order for PE teachers to effectively implement concepts of physical literacy into their teaching curricula, it is important for them to have a sound understanding of the concept which in turn will also benefit their students. PE teachers must also be confident in their ability to teach their students. Conceptualized by Gibson and Dembo (1984) as teachers' ability to bring about teaching to their students and their ability to overcome obstacles that impede their students' learning, the teaching efficacy of PE teachers is essential to their promotion of the concepts of physical literacy. Therefore, the purpose of this research is to examine the relationship between self-perceived physical literacy and teaching efficacy of PE teachers in Hong Kong.

Methods:
A total of 129 PE teachers from different primary and secondary schools in Hong Kong were asked to complete the questionnaire at an annual continuous professional development conference. The questionnaire included basic background information, a validated "Perceived Physical Literacy Instrument" (PPLI) (Sum et al., 2016) for PE teachers, and a "Physical Education Teaching Efficacy Scale" (Humphries, Hebert, Daigle, & Martin, 2012).

Results:
Data analysis revealed that physical literacy has moderately positive correlations with all 7 factors of teaching efficacy in PE teachers. Results also revealed the state of the self-perceived physical literacy and teaching efficacy of PE teachers in Hong Kong and whether or not specific groups of teachers are better equipped to promote the concepts of physical literacy.

Conclusion:
These results are important for helping to determine the prevalence of the concept of physical literacy in Hong Kong and the readiness of the city's teachers to immerse this concept in their teaching curricula.

Reference:
[1] Humphries, C. A., Hebert, E., Daigle, K., & Martin, J. (2012). Development of a Physical Education Teaching Efficacy Scale. *Measurement in Physical Education and Exercise Science, 16*(4), 284–299. http://dx.doi.org/10.1080/1091367X.2012.716726
[2] Gibson, S., & Dembo, M. H. (1984). Teacher efficacy: A construct validation. *Journal of Educational Psychology, 76*, 569–582.
[3] Sum, R. K. W., Ha, A. S. C., Cheng, C. F., Chung, P. K., Yiu, K. T. C., Kuo, C. C., … Wang, F. J. (2016). Construction and Validation of a Perceived Physical Literacy Instrument for Physical Education Teachers. *PLoS ONE*, *11*(5), e0155610. http://doi.org/10.1371/journal.pone.0155610

Validation of Electronic Activity Monitor Devices during Treadmill Walking

Ka-man TAM
Department of Physical Education, The Hong Kong Baptist University

Objectives:
The purpose of this study was to assess the validity of the step count and distance output of commercial electronic activity monitor system (EAMS). Two generations of popular brands, i.e. Fitbit and Mi band were selected for treadmill walking in two single sessions. EAMS models of the same generation (Fitbit Charge & Mi band, Fitbit Charge HR & Mi band 2) were used for assessing its validity in step counter and distance monitor for each session.

Methods:
With reference to the previous research (Takacs et al., 2013), healthy adult (n=30) walked at five predetermined speeds (0.90, 1.12, 1.33, 1.54, 1.78m/s) on a treadmill. Observer step count was taken as the criterion measure for steps and treadmill distance output was considered as the criterion for distance travelled. Validity of the EAMS were assessed by two-factor repeated measures ANOVAs (count x speed) to compare the output of devices with manual step count and treadmill distance data. Also, Bland-Altman plots were constructed to visually inspect the data and to assess agreement with the criterion measures.

Results:
Results revealed that there was no significant difference ($p < 0.05$) in step count between the Fitbit Charge, Fitbit Charge HR and Mi Band 2 activity monitors and the criterions in all treadmill speeds. However, significant differences were noted in both step count and distance measured by Mi band activity monitors and the criterions at all speeds.

Conclusion:
The finding is consistent with other researches that Fitbit activity monitor is a reliable and valid device for step counts. Besides, the advancement in technology makes Mi band 2 as a reliable monitor for counting step. As step counts are a simple way to quantify the amount of physical activity and have been used as a guide to indicate the amount of physical activity. Therefore, further use of EAMS in health promotion is suggested.

Reference:
[1] Takacs, J., Pollock, C. L., Guenther, J. R., Bahar, M., Napier, C., & Hunt, M. a. (2013). Validation of the Fitbit One activity monitor device during treadmill walking. *Journal of Science and Medicine in Sport*. http://doi.org/10.1016/j.jsams.2013.10.241

Children with Physical Disabilities at School and Home: Physical Activity and Contextual Characteristics

Ru Li[1], Cindy H.P. SIT[1], Jane J. YU[1], Raymond K.W. SUM[1], Stephen H. S. WONG[1], Kenneth C.C. CHENG[1], Thomas L. MCKENZIE[2]
[1] Department of Sports Science and Physical Education, the Chinese University of Hong Kong, Shatin, Hong Kong
[2] School of Exercise and Nutritional Sciences, San Diego State University, San Diego, USA

Objectives:
Children with physical disabilities (PD) are much less physically active than both their able-bodied counterparts (Rimmer, Rowland, & Yamaki, 2007) and their peers with other types of disabilities (Sit, Lindner, & Sherrill, 2002). Previous studies have recognized the importance of environmental factors that influence physical activity (PA) participation among children with PD (e.g., Bloemen et al., 2015). Given that homes and schools are both important settings where children can accrue enough PA during the day, it is important to understand how active children with PD are in these settings and what factors may influence their activity levels. Therefore, the purpose of the present study was to (a) assess the levels of PA of children with PD at home and school settings, and (b) examine the association of environmental contextual variables with PA in these settings.

Methods:
Participants were 35 children with PD (Mean age = 15.67 ± 4.30 years; 26 boys) in a special school in Hong Kong. BEACHES (Behaviors of Eating and Activity for Children's Health: Evaluation System) was used to document children's PA and associated environmental characteristics and events at school (recess, lunch break, after-class) and home (before dinner) settings on four normal school days. Dependent variable was the percentage of time spent in moderate-to-vigorous PA (%MVPA), and independent variables included selected contextual characteristics and personal factors such as gender and grade level (primary, junior, senior). Hierarchical multiple regression was used to examine the association of contextual variables with %MVPA at each setting after controlling for age, BMI, and mobility (i.e., walking with or without mobility aid) as confounders.

Results:
Overall, the children were sedentary most of the time (ranging from 86.8% to 92.6%), primarily being sitting down. They spent little time on MVPA (ranging from 7.3% to 13.2%), especially vigorous PA (ranging from 0.7% to 3.7%). Hierarchical multiple regression revealed that selected contextual characteristics explained 18.9%-56.0% ($p < .01$) of the variance predicting %MVPA after controlling for demographic variables. Specifically, at recess setting, prompts to be active from others and presence of *other child* as source of motivator were significant predictors for %MVPA, respectively ($b = .339$, $p < .01$; $b = .288$, $p < .05$). At after-class period, the behavior of viewing media was found to be a significantly negative predictor for %MVPA ($b = -.458$, $p < .05$). While at before dinner setting, presence of father ($b = .558$, $p < .01$) and presence of *father* as source of motivator ($b = .509$, $p < .01$) were significant predictors.

Conclusion:
Overall, children with PD accrued little MVPA either at school or at home. There is substantial need to provide children with PD, especially those unable to walk unassisted, with additional opportunities for PA throughout the day. Additionally, as there were very few prompts for the children to engage in PA in any setting, educating parents and other childcare providers on the importance of PA and how to motivate them may prove relevant.

Reference:
[1] Bloemen, M. A., Backx, F. J., Takken, T., Wittink, H., Benner, J., Mollema, J., & Groot, J. F. (2015). Factors associated with physical activity in children and adolescents with a physical disability: A systematic review. *Developmental Medicine & Child Neurology, 57*(2), 137–148.
[2] Rimmer, J. H., Rowland, J. L., & Yamaki, K. (2007). Obesity and secondary conditions in adolescents with disabilities: Addressing the needs of an underserved population. *Journal of Adolescent Health, 41*(3), 224–229.
[3] Sit, C. H. P., Lindner, K. J., & Sherrill, C. (2002). Sport participation of Hong Kong Chinese children with disabilities in special schools. *Adapted Physical Activity Quarterly, 19*(4), 453–471.

Systematic Review: The Psychological and Behavioural Factors of Unintentional Doping

Tracy TANG[1], Derwin King Chung CHAN[1, 2], Daniel GUCCIARDI[2], Nikos NTOUMANIS[3], James DIMMOCK[4], Robert DONOVAN[4], Sarah HARDCASTLE[3], Martin HAGGER[3,5], Alfred LEE[1]

[1] School of Public Health, The University of Hong Kong

[2] School of Physiotherapy and Exercise Science, Curtin University, Perth, Australia

[3] Health Psychology & Behavioural Medicine Research Group, School of Psychology and Speech Pathology, Curtin University, Perth, Australia

[4] School of Sport Science, Exercise and Health, The University of Western Australia

[5] Department of Sport Science, University of Jyväskylä, Jyväskylä, Finland

A wealth of current research has suggested that doping in sports is an intentional goal-directed behaviour (Hodge, Hargreaves, Gerrard, & Lonsdale, 2013; Lucidi et al., 2008; Ntoumanis, Ng, Barkoukis, & Backhouse, 2014; Tsorbatzoudis, Barkoukis, & Lazuras, 2013). However, both current events and recent research suggest that doping may also occur accidentally in that athletes may unintentionally consume banned performance-enhancing substances via food, supplements and/or medications (Chan, Donovan, et al., 2014). Although the athlete may claim their subsequently adverse analytical findings as accidental, the World Anti-Doping Agency's strict liability policy legally states that "ignorance is no excuse" and a violation of the anti-doping policy, regardless of intention, will still result in the same punishment (World Anti-Doping Agency, 2015). As such, unintentional doping presents as a serious matter as it can result in sanctions against participation in sport, excess fines and the tarnishing of an athlete's reputation. The current study aims to identify the psychological and behavioural factors of unintentional doping and provide initial evidence-based recommendations for agencies, athletes and/or sporting personnel to increase athletes' awareness of, and ability to avoid, unintentional doping in sport. A systematic review using databases of Medline, PsycINFO, PsycTESTS, PsyArticles, Web of Science and the database of the World Anti-Doping Agency on all existing literature concerning the psychology of unintentional doping in sport was conducted. In order to detect any other studies that were not identified via the search engines, snowballing technique was also carried out by manually searching the reference list of each eligible article. Also, to be as inclusive as possible in this new area of research, no restrictions were placed in terms of year of publications, and all published papers up to April 2016 were considered. The searching processes yielded a total of 2,308 articles. After removing duplicates, a manual screening process was done on the remaining 2,110 articles based on the established exclusion criteria. The criteria excluded all studies with sole focuses on intentional doping, methods of doping control/procedures and any general reviews/ discussions about adverse analytical findings or accidental doping. Evidence from the 6 eligible studies suggests that the psychological factors of unintentional doping could be related to a number of behavioural, social and psychological factors. These factors identified were autonomous versus controlled types of motivation, social variables/norms and beliefs. These subsequently motivational factors in adhering to anti-doping behaviours have also been explored by incorporating them into theories such as self-determination theory (Chan, Donovan, et al., 2014; Deci & Ryan, 1985), theory of planned behaviour (Ajzen, 1985, 1991; Chan et al., 2015; Chan, Hardcastle, et al., 2014), integration of both (Chan et al., 2015), and the trans-contextual model (Chan et al., 2015). Furthermore, in the current study, we have also identified a plausible barrier in adhering to anti-doping behaviours of which looks into the factor of self-control within the strength-energy model (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Baumeister, Gailliot, DeWall, & Oaten, 2006). The investigation of the psychological and behavioural processes of anti-doping is still a new area of research, we hope it raises researchers' attention and inspires further studies that also contribute to anti-doping education and practice.

Reference:

[1] Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In J. Kuhl & J. Beckmann (Eds.), *From intentions to actions: A theory of planned behavior* (pp. 11-39). Berlin: Spring

[2] Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211. doi:10.1016/0749-5978(91)90020-T

[3] Baumeister, R. F., Bratslavsky, E., Muraven, M., & Tice, D. M. (1998). Ego depletion: Is the active self a limited resource? *Journal of Personality and Social Psychology, 74*(5), 1252-1265. doi:10.1037/0022-3514.74.5.1252

[4] Baumeister, R. F., Gailliot, M., DeWall, C. N., & Oaten, M. (2006). Self-regulation and personality: How interventions increase regulatory success, and how depletion moderates the effects of traits on behavior. *Journal of Personality, 74*(6), 1773-1801. doi:Doi 10.1111/J.1467-6494.2006.00428.X

[5] Chan, D. K. C., Dimmock, J. A., Donovan, R. J., Hardcastle, S., Lentillon-Kaestner, V., & Hagger, M. S. (2015). Self-determined motivation in sport predicts anti-doping motivation and intention: A perspective from the trans-contextual model. *Journal of Science and Medicine in Sport, 18*(3), 315-322. doi:10.1016/j.jsams.2014.04.001

[6] Chan, D. K. C., Donovan, R. J., Lentillon-Kaestner, V., Hardcastle, S. J., Dimmock, J. A., Keatley, D., & Hagger, M. S. (2014). Young athletes' awareness and monitoring of anti-doping in daily life: Does motivation matter? *Scandinavian Journal of Medicine and Science in Sports, 25*(6), e655-663. doi:10.1111/sms.12362

[7] Chan, D. K. C., Hardcastle, S. J., Lentillon-Kaestner, V., Donovan, R. J., Dimmock, J. A., & Hagger, M. S. (2014). Athletes' beliefs about and attitudes towards taking banned performance-enhancing substances: A qualitative study. *Sport, Exercise, and Performance Psychology, 3*(4), 241-257. doi:10.1037/spy0000019

[8] Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum.

[9] Hodge, K., Hargreaves, E. A., Gerrard, D., & Lonsdale, C. (2013). Psychological mechanisms underlying doping attitudes in sport: Motivation and moral disengagement. *Journal of Sport and Exercise Psychology, 35*(4), 419-432.

[10] Lucidi, F., Zelli, A., Mallia, L., Grano, C., Russo, P. M., & Violani, C. (2008). The social-cognitive mechanisms regulating adolescents' use of doping substances. *Journal of Sports Sciences, 26*(5), 447-456. doi:10.1080/02640410701579370

[11] Ntoumanis, N., Ng, J. Y. Y., Barkoukis, V., & Backhouse, S. H. (2014). Personal and psychosocial predictors of doping use in physical activity settings: A meta-analysis. *Sports Medicine, Advanced online publication*. doi:10.1007/s40279-014-0240-4

[12] Tsorbatzoudis, H., Barkoukis, V., & Lazuras, L. (2013). *Towards and integrative model of doping use: An empirical study with adolescent athletes*.

[13] World Anti-Doping Agency. (2015). *Athlete reference guide to the 2015 world anti-doping code*

The Importance of Recreation Physical Activity in Promoting Physical Literacy among Hong Kong Adolescents

Siu-ming CHOI[1], Raymond Kim Wai SUM[1], Elean Fung Lin LEUNG[2], Robert Siu Kuen NG[2]

[1] Department of Sports Science and Physical Education, Faculty of Education, The Chinese University of Hong Kong

[2] Physical Education Unit, Faculty of Education, The Chinese University of Hong Kong

Objectives:

This study explored the importance of recreation physical activity (PA) to promote physical literacy (PL) among Hong Kong adolescents by using cross-sectional design. With the free-choice recreation PA, the research team assumed that its relationship with PL will be stronger than other domains.

Methods:

A total of 1945 adolescents aged 12-18 years, mean of 14.98 (±1.65) years old (1,028 Male and 917 Female) participated in this study. Perceived Physical Literacy Instrument (PPLI) and International Physical Activity Questionnaire for Adolescent (IPAQ-A) were distributed to the participants from the research assistant and teachers in the first 15 minutes of PE lesson.

Results:

The factors of perceived PL were significantly correlated ($P<0.01$) with the mean score of "Sense of self and Self-confidence" was 10.70 (±*2.22),* "Self-expression and Communication with others" was 10.80 (±2.11) and "Knowledge and Understanding" was 12.01 (±1.90).

The intensities and categories of total PA were significantly correlated ($p<0.01$). Their mean daily intensities minutes for walking, moderate and vigorous were 74, 34 and 27 respectively while their mean categories minutes for school, home, transportation and recreation were 47, 17, 66 and 48 respectively. Especially, recreation PA was significantly correlated ($p<0.01$) with total PA ($R=0.702$), walking ($R=0.517$), moderate ($R=0.631$), and vigorous ($R=0.520$) intensity.

Significant correlation was found in the overall PL and PA ($R=0.227$, $p<0.01$). Although modest, factors in perceived PL, intensities in PA levels and 3 categories (school, transportation and recreation) PA were significantly correlated ($R=0.067–0.292$, $p<0.01$). Particularly, the correlation of recreation PA with 3 factors of PL, i.e. total PL ($R=0.292$), sense of self and self-confidence ($R=0.267$), self-expression and communication with others ($R=0.267$) and knowledge and understanding ($R=0.247$) were the strongest among other categories.

Conclusion:

Compared with other domains, recreation domain PA has a higher freedom of choice. Adolescents participating in more recreation PA can choose activities they prefer who may not follow the PA plan made by school, nor restricted in only housework or transportation domain. In promoting the concept of PL, this is not solely the responsibilities of PE teachers. During recreation PA, parents, coaches and peers can also bring impacts to adolescent' PL lifelong journey to develop their motivation, confidence and physical competence, interaction with the environment, sense of self and self-confidence, self-expression and communication with others, and knowledge and understanding.

Reference:

[1] Booth, M. (2000). Assessment of physical activity: an international perspective. *Res Q Exerc Sport, 71 Suppl 2*, 114-120. doi:10.1080/02701367.2000.11082794

[2] Edwards, L. C., Bryant, A. S., Keegan, R. J., Morgan, K., & Jones, A. M. (2016). Definitions, Foundations and Associations of Physical Literacy: A Systematic Review. *Sports Med*, 1-14. doi:10.1007/s40279-016-0560-7

[3] Giblin, S., Collins, D., & Button, C. (2014). Physical literacy: importance, assessment and future directions. *Sports Med, 44*(9), 1177-1184. doi:10.1007/s40279-014-0205-7

[4] Hagstromer, M., Bergman, P., De Bourdeaudhuij, I., Ortega, F. B., Ruiz, J. R., Manios, Y., . . . Group, H. S. (2008). Concurrent validity of a modified version of the International Physical Activity Questionnaire (IPAQ-A) in European adolescents: The HELENA Study. *Int J Obes (Lond), 32 Suppl 5*, S42-48. doi:10.1038/ijo.2008.182

[5] Longmuir, P. E., Tremblay, M.S. (2016). Top 10 Research Questions Related to Physical Literacy. *Research quarterly for exercise and sport, 87*(1), 28-35. doi:10.1080/02701367.2016.1124671

[6] Sum, R. K., Ha, A. S., Cheng, C. F., Chung, P. K., Yiu, K. T., Kuo, C. C., . . . Wang, F. J. (2016). Construction and Validation of a Perceived Physical Literacy Instrument for Physical Education Teachers. *PLoS One, 11*(5), e0155610. doi:10.1371/journal.pone.0155610

[7] UNESCO. (2015). *Quality Physical Education: Guidelines for Policy Makers*. Paris, France.

[8] Whitehead, M. (2010). *Physical literacy: throughout the lifecourse*. Oxon: Routledge.

[9] WHO. (2010). *Global Recommendations on Physical Activity for Health*. Geneva, Switzerland.

The Impacts of Increasing Physical Activity on Motor Functions, Behaviours, Activity Participation and Quality of Life of Children with Developmental Coordination Disorder

Yoyo Ting-yiu CHENG[1], William Wai-nam Tsang[1,2]; Duncan MACFARLANE[3], Shirley Siu-ming FONG[1,2]
[1]School of Public Health, The University of Hong Kong
[2]Department of Rehabilitation Sciences, The Hong Kong Polytechnic University
[3]Center for Sports and Exercise, The University of Hong Kong

Background:
Developmental coordination disorder (DCD) is a neurodevelopmental motor disorder that affects 6-16% of school-age children[1]. They show problems with motor skill acquisition, coordination, planning and execution, which cannot be explained by intellectual delay, visual impairment or other neurological conditions[2]. It significantly interferes with their daily activities such as walking, jumping, writing and cutting. DCD children demonstrate poorer physical fitness, lower participation in physical activities (PA), higher percentage of overweight/ obesity than their peers [3-4], and have problems with behaviors and social integration [5-6]. Therefore, it is important to encourage them to participate in PA, in order to maximize their physical functions, participation and overall well-being[7].

Objectives:
(1) To promote and increase PA in children with DCD; and (2) to investigate the effects of increasing PA in children with DCD on their motor functions, behaviors, activity participation and quality of life (QOL).

Methods:
A pretest-posttest control group intervention study was conducted in 70 DCD children, who were randomly assigned into two groups – PA group (n = 33) and control (n = 77). DCD children in the PA group were given an educational talk, pamphlet and two exercise sessions to teach them the importance of PA and home exercises. They were then asked to purposefully increase their PA for 8 weeks. Those in the control group were instructed to continue with their usual daily activities. Logbooks were distributed to them to record the types, intensity and duration of PA. Their physical activity levels (in metabolic equivalent [MET] hours per week) were then calculated for later analysis. Their motor performance, behaviors, activity participation and quality of life (QOL) were evaluated with four self-administered questionnaires, namely Developmental Coordination Disorder Questionnaire 2007 (DCDQ'07), Child Behaviour Checklist (CBC), the Children's Assessment of Participation and Enjoyment (CAPE) and Pediatric Quality of Life Inventory (PedsQL 4.0 SF15), respectively. The results before and after the 8-week intervention period were compared.

Results:
The physical activity level in the PA group increased significantly by 9.1 MET hours per week ($p < 0.001$), while that in the control group remained similar after 8 weeks ($p = 0.814$). A significant between-group difference in the PA level was found ($p = 0.039$). Both groups demonstrated a significantly higher motor performance score on the DCDQ (PA group $p = 0.003$ and control group $p = 0.015$) and a significantly higher Child Physical Score on PedsQL (PA group $p = 0.017$ and control group $p = 0.049$) after 8 weeks. Yet, no significant between-group differences were detected. Other items of the four questionnaires did not show any significant changes.

Conclusion:
The self-rated motor performance and QOL in the physical domains of DCD children seem to improve over time. Despite a significant increase in the PA in DCD children, it did not bring about any significant changes in the self-reported motor functions, behaviors, activity participation and QOL. Further studies using objective measurements are needed to confirm the results, and follow-up assessments are required to monitor their progress over time.

Acknowledgement:
This study was supported by the HKU 81 Inclusion Fund from the University of Hong Kong.

Reference:
[1] Visser, J., 2003. Developmental coordination disorder: A review of research on subtypes and comorbidities. *Human Movement Science,* 22, pp.479–493.
[2] American Psychiatric Association, 2000. *Diagnostic and statistical manual of mental disorders* 4th ed., Washington, DC.
[3] Cairney, J. et al., 2005. Developmental coordination disorder, self-efficacy toward physical activity, and play: Does gender matter? *Adapted Physical Activity Quarterly*, 22, pp.67–82.
[4] Fong, S.S.M. et al., 2011. Motor ability and weight status are determinants of out-of-school activity participation for children with developmental coordination disorder. *Research in Developmental Disabilities*, 32(6), pp.2614–2623. Available at: http://dx.doi.org/10.1016/j.ridd.2011.06.013.
[5] Skinner, R. a. & Piek, J.P., 2001. Psychosocial implications of poor motor coordination in children and adolescents. Human Movement Science, 20, pp.73-94.
[6] Kanioglou, A., Tsorbatzoudis, H. & Barkoukis, V., 2005. Socialization and behavioral problems of elementary school pupils with developmental coordination disorder. Perceptual and motor skills, 101, pp.163-173.
[7] Rivilis, I. et al., 2011. Physical activity and fitness in children with developmental coordination disorder: A systematic review. *Research in Developmental Disabilities*, 32(3), pp.894–910. Available at: http://dx.doi.org/10.1016/j.ridd.2011.01.017. WHO, 2011. Physical-Activity-Recommendations-5-17Years. Available at: http://www.who.int/dietphysicalactivity/physical-activity-recommendations-5-17years.pdf?ua=1 [Accessed March 9, 2015].

Factors Influencing Physical Literacy of Adolescents – Experience on Developing a PPLI-A Instrument

Fong-jia WANG[1]*; Raymond Kim Wai SUM* [2]
Department of Sports Science and Physical Education, The Chinese University of Hong Kong

The purpose of this presentation is to share experience on developing a "Perceived Physical Literacy Instrument for Adolescents" (PPLI-A) and discuss factors influencing physical literacy of adolescents. The participants (N = 1,945; age range 11-19) were recruited from secondary schools in Hong Kong and completed an 9-item perceived physical literacy instrument (PPLI) for PE teachers (Sum et al., 2016) as the initial tests. This self-report measure, using a 5-point Likert scale, formed the PPLI-A. The sample was randomly split, and exploratory and confirmatory factor analyses resulted in an 9-item scale remained, 3-factor scale. Exploratory factor analysis (EFA) item loadings ranged from 0.52 to 0.87, and Cronbach's alpha ranged from 0.7 to 0.92. Confirmatory factor analysis (CFA) showed that the construct demonstrated good fit to the model. The PPLI-A is a valid, reliable and suitable instrument that can be measured the perceived physical literacy of adolescents. We suggested the PPLI-A instrument can be used for both research and applied purposes and potential uses for the instrument in association with physical education, sports and physical activity settings that elevate the awareness of perceived physical literacy of adolescents. This research appears to be consistent with the attributes in the literature: 1) motivation, 2) confidence and physical competence, 3) interaction with the environment, 4) sense of self and self-confidence, 5) self-expression and communication with others, and 6) knowledge and understanding (Whitehead, 2001). Reflection on developing PPLI-A will be the focus of this presentation.

Keywords: perceived physical literacy; adolescents; instrument development

Effect of Real-time Auditory Feedback on Impact Loading before and after Running Retraining

Ivan Pui-hung AU[1], Winko Wen-kang AN[1], Janet Han-wen ZHANG[1], Zoe Yau-shan CHAN[1], Kin-hung TING[1], Irene DAVIS[2], Roy Tsz-hei CHEUNG[1]

[1]Gait & Motion Analysis Laboratory, Department of Rehabilitation Sciences, The Hong Kong Polytechnic University, Hong Kong

[2]Spaulding National Running Center, Department of Physical Medicine and Rehabilitation, Harvard Medical School, Harvard University, USA

Objectives:

High impact loading during running has been associated with overuse musculoskeletal injuries, such as plantar fasciitis and tibial stress fractures[1,2]. To reduce the risk of overuse musculoskeletal injuries, real-time biofeedback running retraining was found to be an effective method in lowering impact loading[3]. However, most of the previous gait retraining used visual feedback while other feedback types have not been fully studied. More importantly, the effect of biofeedback before and after training was not addressed and such information may inform the limitation of current protocol. Hence, this study sought to examine the efficacy of real-time auditory feedback running retraining on reducing impact loading. We also evaluated the effect of additional auditory feedback before and after the training.

Methods:

Nine recreational runners (3 females and 6 males) were recruited from local running clubs. A light weight tri-axial accelerometer was firmly attached to the posterior aspect of the right shoe aligning with the long axis of the tibia to measure the peak positive acceleration (PPA) during landing. They were asked to land softer during running with and without real-time auditory feedback after the establishment of baseline PPA. The landing PPA, vertical average (VALR) and instantaneous (VILR) loading rates were reassessed after a course of 2-week running retraining with real-time auditory feedback.

Results:

Two-way ANOVA indicated a non-significant interaction between auditory feedback and training among all variables ($F < 2.842$, $P > 0.130$). Pairwise comparisons reported a significant reduction in landing PPA, VALR and VILR after training, regardless of the presence of the additional feedback (without feedback: PPA: $P = 0.002$, Cohen's d = 0.99; VALR: $P = 0.004$, Cohen's d = 1.42; VILR: $P = 0.018$, Cohen's d = 1.07; with feedback: PPA: $P = 0.007$, Cohen's d = 0.74; VALR: $P = 0.010$, Cohen's d = 1.07; VILR: $P = 0.042$, Cohen's d = 0.84). Lower landing PPA was found in runners with auditory feedback before ($P = 0.003$, Cohen's d = 0.57) and after ($P = 0.048$, Cohen's d = 0.37) running retraining. However, VALR and VILR in runners with auditory feedback were only lowered before (VALR: $P = 0.002$, Cohen's d = 0.82; VILR: $P = 0.001$, Cohen's d = 0.81), but not after training (VALR: $P = 0.092$, Cohen's d = 0.24; VILR: $P = 0.086$, Cohen's d = 0.23).

Conclusion:

Real-time auditory running retraining is effective in reducing impact loading in runners. The real-time auditory feedback is effective for untrained runners in impact loading control, while the effect of additional auditory feedback is limited after training.

Reference:

[1] Pohl MB, Hamill J, Davis IS. Biomechanical and anatomic factors associated with a history of plantar fasciitis in female runners. *Clin J Sport Med*. 2009;19(5):372-376. doi:10.1097/JSM.0b013e3181b8c270.

[2] Davis I, Milner CE, Hamill J. Does increased loading during running lead to tibial stress fractures? A propective study. *Med Sci Sport Exerc*. 2004;36(5):S58. doi:10.1097/00005768-200405001-00271.

[3] Crowell HP, Davis IS. Gait retraining to reduce lower extremity loading in runners. *Clin Biomech*. 2011;26(1):78-83. doi:10.1016/j.clinbiomech.2010.09.003.

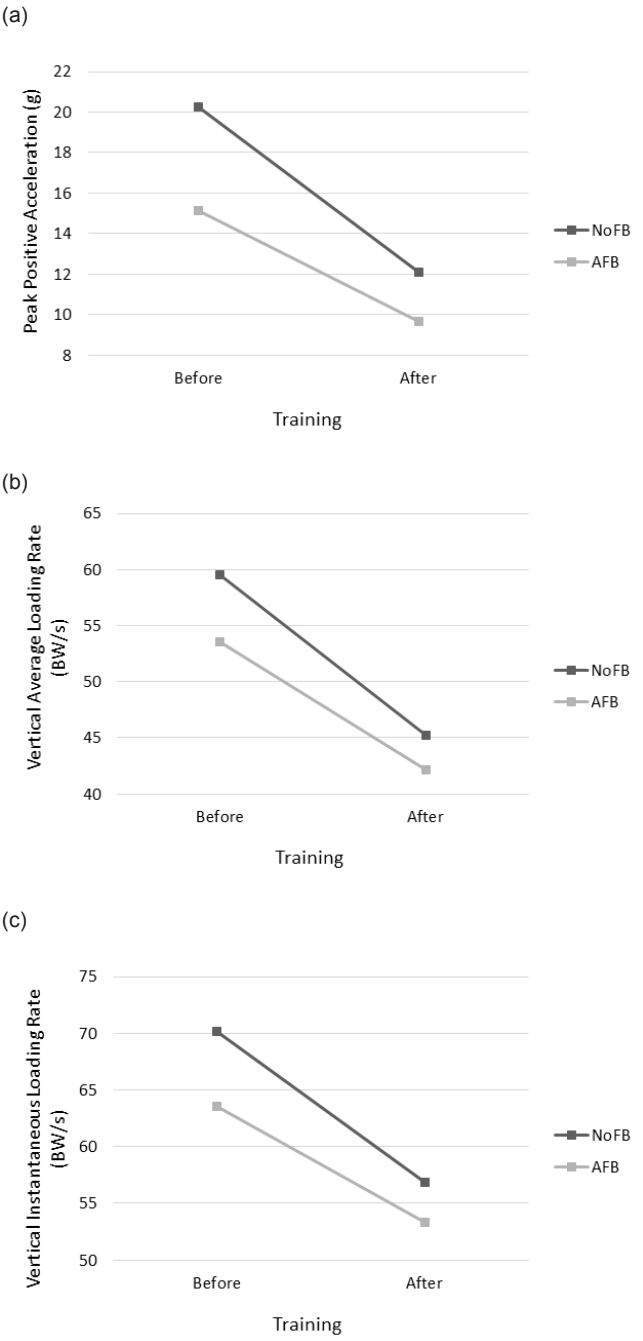


Figure 1. Effects of auditory feedback on (a) landing peak positive acceleration, vertical (b) average and (c) instantaneous loading rates before and after running retraining. BW = body weight; NoFB = No feedback; AFB = Auditory feedback. * indicates significant difference ($P \leq 0.05$).

Learning to Run: Consistency of Motor Modules among Experienced but Not Novice Runners

Ben Man-fei CHEUNG[1], Gabriel Tak-kiu PUN[2], Roy Tsz-hei CHEUNG[2], Vincent Chi-kwan CHEUNG[1]
[1]School of Biomedical Science, The Chinese University of Hong Kong
[2]Gait & Motion Analysis Laboratory, Department of Rehabilitation Sciences, The Hong Kong Polytechnic University

Objectives:
Running is a basic human instinct that may be shaped more by nature than nurture, as some have argued (Bramble & Lieberman, 2004). The biomechanics of running is also highly complex. Emerging evidence suggests that the central nervous system circumvents the high complexity and dimensionality of human movement by activating muscle groups together as individual motor modules, and by generating diverse muscle patterns through their flexible, linear combination of (Bizzi & Cheung, 2013). These modules can be extracted from electromyography (EMG) signals using the non-negative matrix factorization algorithm (Lee & Seung, 1999). Here, we seek to unravel the motor modules required for running, and to investigate how training may influence their structures. Specifically, we compared the between-subject motor-module variability between novice and experienced runners. We hypothesized that the motor modules for running would be robust across subjects regardless of their prior running experience, consistent with the view that running is primarily shaped by inborn, genetic factors.

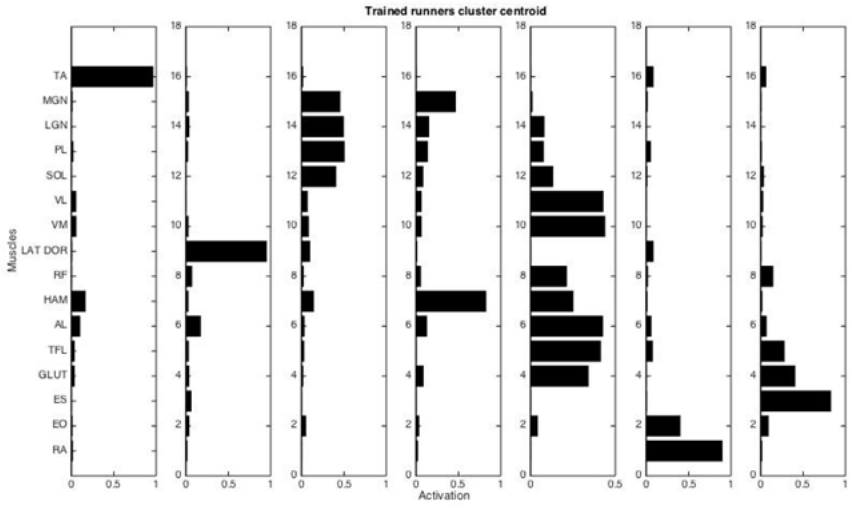
Methods:
Fourteen novice (<3 mo experience) and six experienced (>=12 mo) runners were recruited. All participants were free from any injury in the past 12 mo. After obtaining written consents, we instructed them to run on an instrumented treadmill at two different self-selected speeds. Four minutes of EMGs were collected from 16 trunk and leg muscles using a wireless system (Trigno, Delsys, Boston, MA, USA) after treadmill adaptation (Chvatal et al, 2011).

Raw EMGs from the dominant leg were high-pass filtered at 50 Hz, rectified, and then low-pass filtered at 20 Hz before normalization. Motor modules were extracted from the EMGs using non-negative matrix factorization. K-means clustering was then performed to categorize all motor modules from all subjects into clusters. The number of clusters yielding a maximum silhouette index was selected as best representation of the data set (Rousseeuw, 1987). The number of motor-module clusters for the experienced group was then compared with that for the novice group. Statistical significance of this comparison was assessed by the Mann-Whitney U test after within-group bootstrapping of the modules with replacement.

Results:
Contrary to our hypothesis, novice runners demonstrated higher between-subject motor-module variability as compared with experienced runners. The group of novice runners showed more motor-module clusters (median=10) than the experienced group (median=7, p<0.001). Motor modules of experienced runners also demonstrated more co-activation of multiple muscles while modules of novice runners had more single-muscle components (Figure 1). Moreover, the interpersonal variability of novice subjects can be demonstrated by the cluster size of each cluster (Figure 2). Nonetheless, it is also noted that some motor modules were consistent across both groups, indicating that some modules are indispensable in running regardless of experience.

Conclusion:
Novice runners had higher interpersonal variability of motor modules than experienced runners. It is possible that novice runners adopt different strategies for motor control initially, and subsequently converge to a consistent set of modules suited for the biomechanical demands of running. As argued by our results, untrained subjects might not naturally possess the necessary neuromuscular infrastructure required for the best running performance. Running optimally demands nurture in addition to nature.

Reference:
[1] Bizzi et al. "The Neural Origin of Muscle Synergies." *Frontiers in Computational Neuroscience*
[2] Bramble et al. "Endurance Running and the Evolution of Homo." *Nature* 432
[3] Chvatal et al "Common Muscle Synergies for Control of Center of Mass and Force in Nonstepping and Stepping Postural Behaviors." *Journal of Neurophysiology*
[4] Lee et al "Learning the Parts of Objects by Non-Negative Matrix Factorization." *Nature* 401
[5] Rousseeuw, Peter J. "Silhouettes: A Graphical Aid to the Interpretation and Validation of Cluster Analysis." *Journal of Computational and Applied Mathematics*



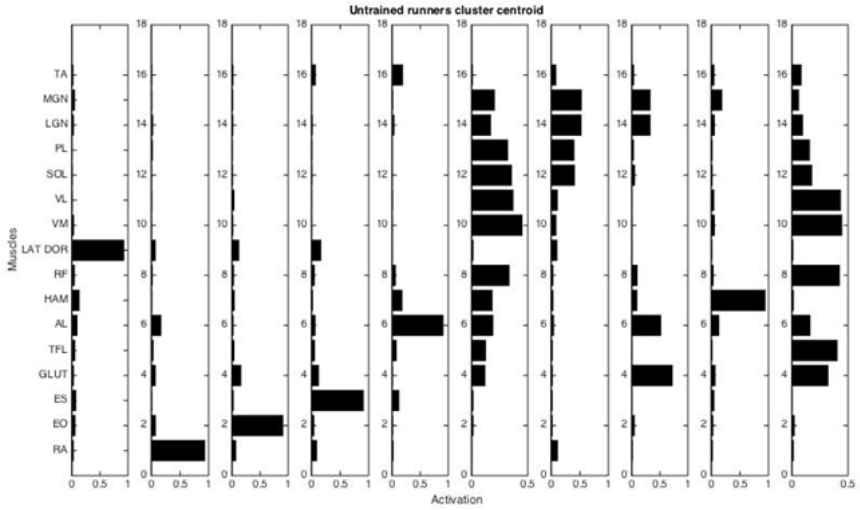


Figure 1: Motor modules representing the cluster centroid for experienced (top) and novice runners (bottom). Activation of each muscle was scaled from 0 to 1 with 1 indicating maximal activation.
TA: Tibialis Anterior, MGN: Medial Gastrocnemius, LGN: Lateral Gastrocnemius, PL: Peroneus Longus, Sol: Soleus, VL: Vastus Lateralis, VM: Vastus Medialis, Lat Dor: Latissimus Dorsi, RF: Rectus Femoris, Ham: Hamstrings, AL: Adductor Longus, TFL: Tensor Fasciae Latae, Glut: Gluteus Maximus, ES: Erector Spinae, EO: External Oblique, RA: Rectus Abdominalis

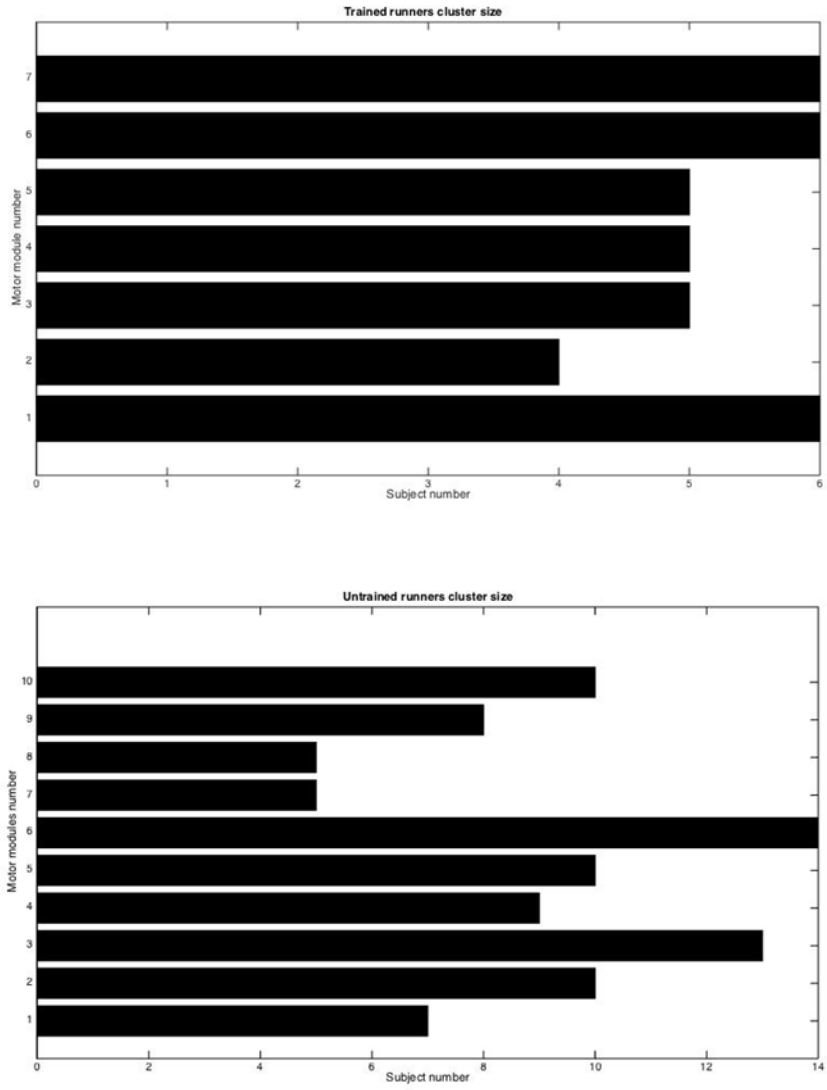


Figure 2: Cluster size of each cluster for experienced (top) and novice runners (bottom). Each cluster was plotted against the number of motor module that it contains.

Immediate and Short Term Effect of Running Shoes in Habitual Barefoot Runners

Fannie On-yue LAU, Ivan Pui-hung AU, Winko Wen-kang AN, Janet Han-wen ZHANG, Tony CHEN, Roy Tsz-hei CHEUNG
Gait & Motion Analysis Laboratory, Department of Rehabilitation Sciences, The Hong Kong Polytechnic University, Hong Kong

Objectives:
Previous studies have examined and compared the biomechanical characteristics of habitual barefoot runners and habitual shod runners1–3but the modern running shoe was not invented until the 1970s. For most of human evolutionary history, runners were either barefoot or wore minimal footwear such as sandals or moccasins with smaller heels and little cushioning relative to modern running shoes. We wondered how runners coped with the impact caused by the foot colliding with the ground before the invention of the modern shoe. Here we show that habitually barefoot endurance runners often land on the fore-foot (fore-foot strike. It is speculated that human may adopt a non-rearfoot (forefoot or midfoot) strike before the invention of modern footwear in order to lower injury risk and discomfort. In fact, the mechanical behavior during the adaptation period in transiting from barefoot running to shod running remains unknown. Hence, this study investigated the immediate and short-term (up to 1-month follow-up) effects of traditional running shoes (TRS) and minimal shoes (MS) on the running biomechanics in a group of habitual barefoot runners from Nyarima, Kenya.

Methods:
Twelve habitual barefoot runners were recruited from a running team (>= 100 km/week for at least 4 years), and were randomly assigned to TRS and MS group. Subjects in the TRS and MS groups were given a pair of TRS and MS respectively to run for one month. Average and instantaneous vertical loading rates, footstrike pattern, overstride, knee and ankle excursion during overground running were obtained before, immediate after, and one-month after the shoe prescription. A 2x3 repeated measures ANOVA was used to compare the vertical loading rates, footstrike angle, and joint kinematics between shoe type (TRS and MS) and time (pre-shod, post-shod, and 1-month follow-up). Pairwise comparison was conducted if applicable. Effect size, expressed as partial Eta squared (was calculated.

Results:
Regardless of the shoe type, the average and instantaneous vertical loading rates at the 1-month follow-up were significantly higher than that at the pre-shod session ($p < 0.034$, $\eta 2p > 0.474$, Figure 1). In addition, barefoot runners with TRS tended to land with rearfoot strike when compared with runners with MS, as indicated by a significantly lower footstrike angle in the TRS group ($p = 0.045$, $\eta 2p = 0.585$, Figure 2). However, habitual barefoot runners did not appear to alter their lower limb kinematics when running with TRS or MS. There was no significant time or shoe effect on overstride, knee, and ankle excursion ($p > 0.061$).

Conclusion:
Habitual barefoot runners appear to land with greater impact during shod running and they tend to have rearfoot strike with TRS. Lower limb kinematics, however, is comparable before and after transiting to shod running. Longer period of follow-up is suggested to further investigate the footwear effect on the running biomechanics in habitual barefoot runners.

Reference:
[1] Lieberman DE, Venkadesan M, Werbel W a, et al. Foot strike patterns and collision forces in habitually barefoot versus shod runners. *Nature*. 2010;463(7280):531-535. doi:10.1038/nature08723.
[2] Pontzer H, Suchman K, Raichlen DA, Wood BM, Mabulla AZP, Marlowe FW. Foot strike patterns and hind limb joint angles during running in Hadza hunter-gatherers. *J Sport Heal Sci*. 2014;3(2):95-101. doi:10.1016/j.jshs.2014.03.010.
[3] Lieberman DE, Castillo ER, Otarola-Castillo E, et al. Variation in foot strike patterns among habitually barefoot and shod runners in Kenya. Balasubramaniam R, ed. *PLoS One*. 2015;10(7):e0131354. doi:10.1371/journal.pone.0131354.

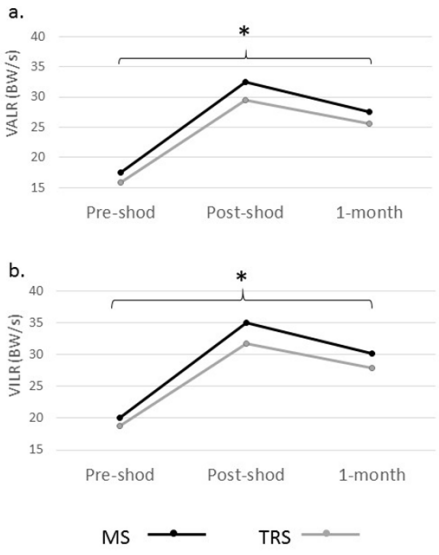


Figure 1. Comparison of (a) Vertical average loading rate (VALR) and (b) Vertical instantaneous loading rate (VILR) between minimal shoes and traditional running shoes group at three selected time points (pre-shod, post-shod, and 1-month follow-up).
BW = Body weight. *P < 0.05

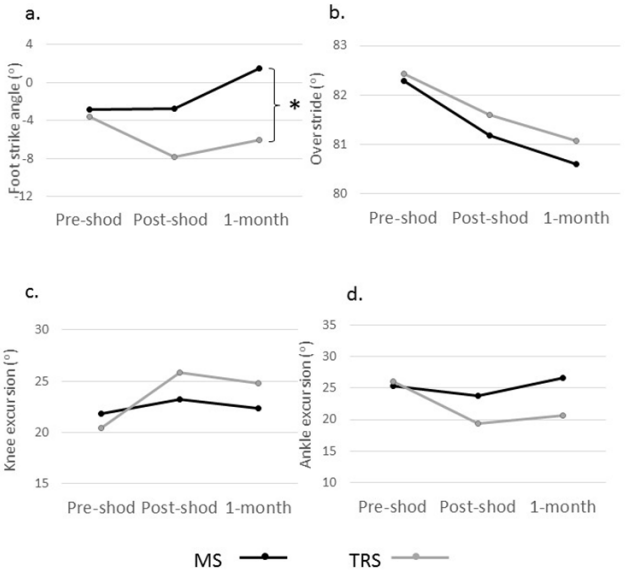


Figure 2. Comparison of (a) foot strike angle, (b) overstride, (c) knee excursion, and (d) ankle excursion between minimal shoes and traditional running shoes group at three selected time points (pre-shod, post-shod, and 1-month follow-up)
*P < 0.05

Table 1. Kinetic and Kinematic differences between minimal shoes and traditional running shoes group at three selected time points (pre-shod, post-shod, and 1-month follow-up)

Variables	MS			TRS		
	Pre-shod	Post-shod	1-month	Pre-shod	Post-shod	1-month
Kinetics						
VALR (BW/s)	17.60 ± 9.55	32.47 ± 14.51	27.47 ± 9.29	15.84 ± 6.65	29.43 ± 12.00	25.64 ± 3.06
VILR (BW/s)	20.11 ± 9.24	35.01 ± 15.09	30.23 ± 9.42	18.73 ± 6.77	31.79 ± 13.11	27.93 ± 3.27
Kinematics						
Footstrike angle (°)	-2.86 ± 7.52	-2.76 ± 7.11	1.55 ± 12.35	-3.58 ± 6.82	-7.79 ± 8.11	-6.03 ± 8.81
Overstride (°)	82.28 ± 3.25	81.18 ± 1.56	80.60 ± 1.80	82.43 ± 2.92	81.59 ± 4.39	81.08 ± 5.00
Knee excursion (°)	21.87 ± 3.44	23.22 ± 3.89	22.40 ± 6.89	20.40 ± 5.49	25.82 ± 5.54	24.79 ± 8.20
Ankle excursion (°)	25.40 ± 6.27	23.80 ± 8.59	26.63 ± 9.04	26.05 ± 6.05	19.36 ± 6.25	20.67 ± 9.30

Data are presented as mean ± standard deviation.

The Pattern of Impact Acceleration during Distance Running

Shi-wei MO, Daniel H.K. CHOW
Department of Health and Physical Education, The Education University of Hong Kong

Background:
Previous study showed that repetitive impact force at landing during a distance run was related to overuse injuries. As the pattern of impacts over running time, which is imperative for understanding running injuries, has never been fully explored and as the variability of such impacts might reveal vital information of the system coordinating various internal and external factors during shock attenuation, this study investigated the pattern of impact acceleration during a distance run.

Methods:
Eight participants (19.8 ±1.4 years; 166.1 ± 10.4 cm; 58.9 ± 9.6 kg) with different running experiences (0-20 years) were required to run 3.2 km (8 laps) at his/her preferred speed on a standard outdoor track. Accelerations were incessantly recorded using 7 inertial measurement units attached to the pelvis, and bilateral thigh, shank, and foot while fatigue status in each lap was assessed using the Borg's RPE (rate of perceived exertion) Scale.

Peak impact accelerations (PIAs) were extracted from 10 gait cycles in each lap, and the percent of PIAs reduction (%) was calculated. Mean and standard deviations (SD) of each participant were computed from the 10 gait cycles in each lap for assessing the pattern of impact acceleration over running time.

Results:
Mean and SD values showed no statistical change in PIAs over time. The PIAs of the foot, thigh and pelvis decreased gradually at the first 5 or 6 laps and increased slightly afterwards while that of the shank increased continuously. Variability continued to increase slightly throughout the run (Fig. 1).

The percent of PIAs reduction of the shank increased continuously at the first 5 laps and decreased at the last 3 laps while those of the thigh and pelvis increased gradually throughout the run. The variability of the percent of PIAs reduction declined at the first 4 laps and increased at the last 4 laps (Fig. 2).

Conclusion:
A non-linear pattern of impact acceleration over running time was observed during a 3.2 km run. The gradual reduction of impact acceleration at the initial period might be attributable to better shock attenuation strategy while the increase at the latter period might be an indication of system failure in shock absorption induced by muscle fatigue.

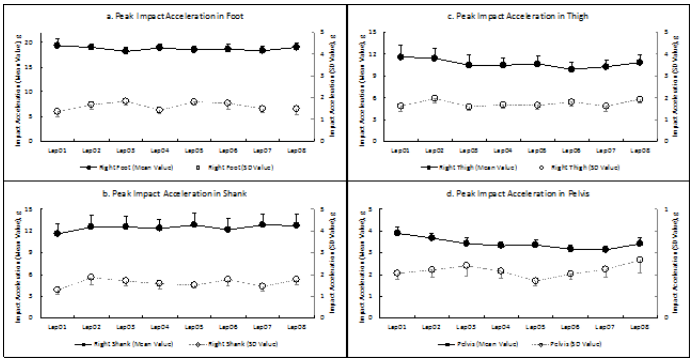


Fig. 1. Mean (SE) peak impact accelerations of right foot (a), right shank (b), right thigh (c), and pelvis (d).

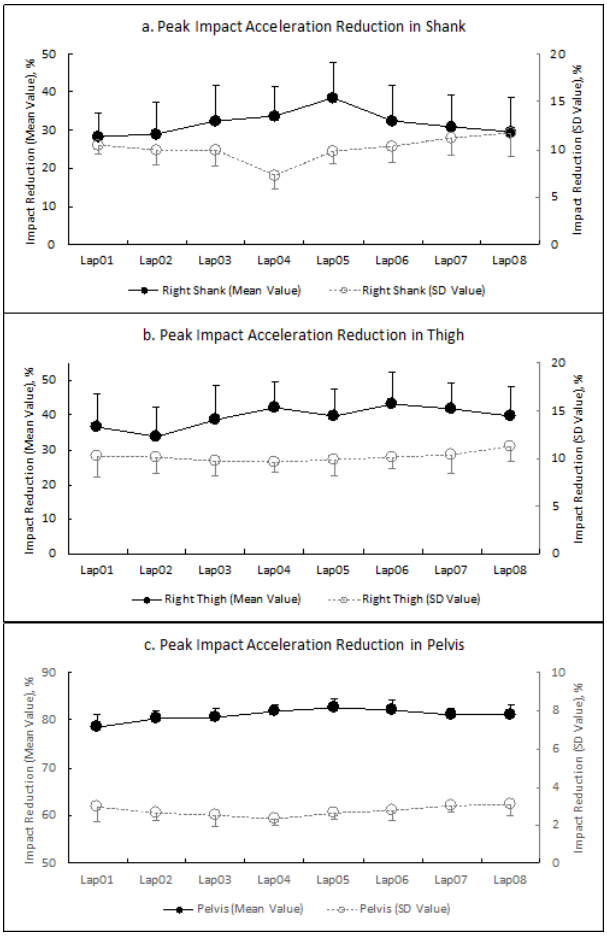


Fig. 2. Mean (SE) percent of PIAs reduction of right shank (a), right thigh (b), and pelvis (c).

Reference:
[1] Derrick, T. R., Dereu, D., & McLean, S. P. (2002). Impacts and kinematic adjustments during an exhaustive run. Med Sci Sports Exerc, 34(6), 998-1002.
[2] García-Pérez, J. A., Pérez-Soriano, P., Llana Belloch, S., Lucas-Cuevas, Á. G., & Sánchez-Zuriaga, D. (2014). Effects of treadmill running and fatigue on impact acceleration in distance running. Sports Biomech, 13(3), 259-66.
[3] James, S. L., Bates, B. T., & Osternig, L. R. (1978). Injuries to runners. Am J Sports Med, 26(2), 40-50.
[4] Mercer, J. A., Bates, B. T., Dufek, J. S., & Herljac, A. (2003). Characteristics of shock attenuation during fatigued running. J Sports Sci, 21(11), 911-9.
[5] Verbitsky, O., Mizrahi, J., Voloshin, A., Treiger, J., & Isakov, E. (1998). Shock transmission and fatigue in human running. J Appl Biomech,14(3),

Kinetics Control in Runners at Different Running Speeds and Slopes after Completion of a Gait Retraining Program

Janet Han-wen ZHANG, Winko Wen-kang AN, Ivan Pui-hung AU, Zoe Yau-shan CHAN, Roy Tsz-hei CHEUNG
Gait & Motion Analysis Laboratory, Department of Rehabilitation Sciences, The Hong Kong Polytechnic University, Hong Kong

Objectives:
Peak acceleration (PA) measured at distal tibia was reported to associate with impact loading during running [1,2] and has been used as a real-time feedback in previous running gait retraining programs [3]. Such running gait retraining programs were shown to be able to reduce impact loading [3,4] and ease symptoms of running-related injuries [5,6]. However, most of the running gait retraining programs were conducted at self-paced speed and on a flat running surface. Whether the learning effect can be maintained while running in untrained conditions remains unknown. Thus, the aim of this study was to compare the PA at distal tibia before and after a gait retraining program at different running speeds and slopes.

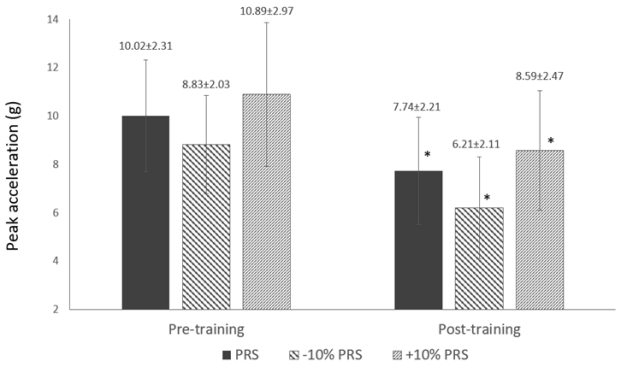
Methods:
Twelve runners (8 males and 4 females; experience > 2 years; weekly running distance >= 20 km/week) were recruited from local running clubs. Their preferred running speeds (PRS) were measured during a 5-minute warm-up treadmill running before the baseline assessment. During the baseline assessment, all the runners were asked to run on an instrumented treadmill (AMTI, Watertown, MA, USA) at three different speeds (PRS and ±10% of PRS) and three different surface inclinations (level, 10% uphill and downhill). A wireless accelerometer was firmly affixed onto the anterior-medial surface of distal tibia. In each running condition, subjects were asked to run for 3 minutes and the PA at distal tibia acceleration in the last 10 footfalls in each running condition were then identified.

After the baseline test, all subjects underwent a gait retraining program with established protocol [3]. During the training, subjects ran at their PRS on a treadmill and PA at distal tibia was used as a real-time feedback for softer landing. After the gait training, a post-training test, which was identical with the baseline evaluation, was conducted. Repeated measures ANOVA were used to assess the effect of training and running conditions. When indicated, post-hoc comparisons with Bonferroni correction were conducted. Global alpha was set at 0.05.

Results:
No interaction effect was found between training and running speeds (P = 0.787) or slopes (P = 0.070). Runners demonstrated lower PA at distal tibia at an untrained running speed after gait retraining (P < 0.05, Effect size = 1.10-1.57) during level running (Figure 1). However, we did not find a lower PA during uphill (P = 0.10, Effect size = 0.47) or downhill (P = 0.05, Effect size = 0.58) running after the program (Figure 2).

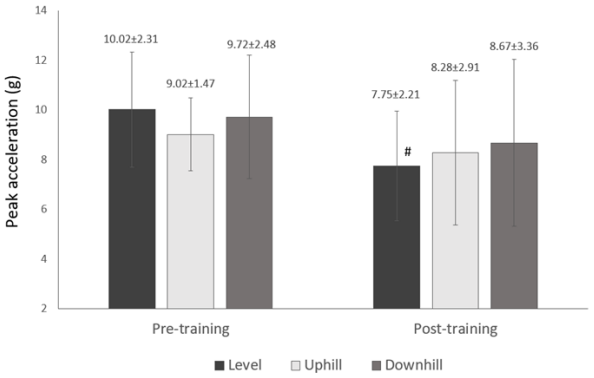
Conclusion:
After the completion of gait retraining program, runners demonstrated reduction of impact loading at PRS on a flat surface. Such learning effect appeared to sustain across all test speeds. However, effect of gait retraining may not carry over when running at different slopes. Our findings suggest limitations of current gait retraining protocol and modification of training is therefore warranted.

Reference:
[1] E. Fortune, M.M. Morrow, K.R. Kaufman, J. Appl. Biomech. 30 (2014) 668–674.
[2] J.H. Zhang, W.W. An, I.P.H. Au, T.L. Chen, R.T.H. Cheung, Gait Posture 46 (2016) 53–56.
[3] H.P. Crowell, I.S. Davis, Clin. Biomech. 26 (2011) 78–83.
[4] R.W. Willy, I.S. Davis, J. Orthop. Sports Phys. Ther. 43 (2013) 864–874.
[5] R.T.H. Cheung, I.S. Davis, J. Orthop. Sports Phys. Ther. 41 (2011) 914–919.
[6] B. Noehren, J. Scholz, I. Davis, Br. J. Sports Med. 45 (2011) 691–696.



* Significantly different from the matching pre-training condition (P < 0.05)

Figure 1 Peak acceleration in different running speed between pre- and post-training assessment



Significantly different from the matching pre-training condition (P < 0.05)

Figure 2 Peak acceleration in different slopes between pre- and post-training assessment

Free Paper Presentation III

Real Time Feedback Gait Retraining Improves Symptoms in Patients with Knee Osteoarthritis: A Randomized Controlled Trial

Ivan Pui-hung AU[1], Winko Wen-kang AN[1], Janet Han-wen ZHANG[1], Zoe Yau-shan CHAN[1], Kevin Ki-wai HO[2], Michael RAINBOW[3], Roy Tsz-hei CHEUNG[1]

[1] Gait & Motion Analysis Laboratory, Department of Rehabilitation Sciences, The Hong Kong Polytechnic University, Hong Kong

[2] Department of Orthopaedics and Traumatology, The Chinese University of Hong Kong, Hong Kong

[3] Department of Mechanical and Materials Engineering, Queen's University, Canada

Objectives:

The knee adduction moment (KAM) is a well-accepted surrogate measure of medial knee compartment compression. This study sought to investigate the effectiveness of a real time feedback gait retraining program targeting reduction of the KAM in patients with early knee osteoarthritis.

Methods:

Twenty patients (10 males and 10 females) with early knee osteoarthritis (Kellgren & Lawrence grade=I or II) and self-reported knee pain were recruited and assigned to a gait retaining group or a control group by stratified randomization. Subjects in the gait retraining group received a 6-week KAM gait retraining (one session per week) according to an established protocol1. Specifically, they were asked to walk at a self-selected speed on an instrumented treadmill while real time KAM data were displaying on a monitor in front of the treadmill. They were told to modify their gait pattern to reduce the amplitude of the KAM. The training time was increased from 15 to 30 minutes and the real time feedback was gradually removed over the last three sessions. Subjects in the control group performed walking exercise on treadmill at self-selected speed and the training time was identical to the gait retraining group. Before and after training, KAM was computed using inverse dynamics and symptoms were evaluated with the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) score.

Results:

Gait retraining reduced KAM by 22.1% (P<0.001) and WOMAC score was improved by 40.7% (P=0.001). Specifically, pain and physical function sub-scores were improved by 48.3% (P=0.001) and 41.2% (P=0.001) respectively in the training group. The KAM remained similar in the control group (P=0.208), while there was a trend of improvement in the WOMAC score (P=0.058) (Table 1).

Conclusion:

Six-week real time feedback gait retraining significantly reduces the KAM in patients with early knee osteoarthritis and improves their symptoms. However, treadmill walking alone may also improve pain and physical function. A prospective study with longer follow-up is warranted.

Reference:

[1] Shull PB, Silder A, Shultz R, et al. Six-week gait retraining program reduces knee adduction moment, reduces pain, and improves function for individuals with medial compartment knee osteoarthritis. *J Orthop Res.* 2013;31(7):1020-1025. doi:10.1002/jor.22340.

Table 1. Knee adduction moment and WOMAC scores at pre- and post-training assessments

	Gait retraining group					Control group				
	Pre	Post	Percentage change	*P*	Cohen's d	Pre	Post	Percentage change	*P*	Cohen's d
Knee Adduction Moment (Nmm/BW*Ht)	0.035 (0.005)	0.028 (0.005)	-22.1	0.000	-1.48	0.032 (0.006)	0.033 (0.005)	2.2	0.208	0.13
WOMAC Scores										
Total	28.5 (8.1)	16.9 (9.0)	-40.7	0.001	-1.36	23.3 (7.5)	21.5 (7.1)	-7.7	0.058	-0.25
Pain	6.0 (2.5)	3.1 (2.1)	-48.3	0.001	-1.25	4.5 (2.5)	4.0 (2.3)	-11.1	0.096	-0.21
Stiffness	2.6 (1.3)	2.1 (1.4)	-19.2	0.213	-0.37	2.0 (0.9)	2.2 (0.8)	10.0	0.343	0.23
Physical Function	19.9 (4.9)	11.7 (6.0)	-41.2	0.001	-1.50	16.8 (4.9)	15.3 (5.0)	-8.9	0.091	-0.30

Data are presented as Mean (SD); BW=Body weight; Ht=Height.

Effect of Facilitatory Kinesio Tape on Muscle Activity and Performance in Regular Users and Non-users

Dominic Ngo-tung MAK[1], Ivan Pui-hung AU[2], Mavis CHAN[2], Zoe, Yau-shan CHAN[2], Winko Wen-kang AN[2], Janet Han-wen ZHANG[2], Kenny WONG[2], Ann SO[2], Nora CHAN[2], Chris KWOK[2], Patrick LAU[2], Roy Tsz-hei CHEUNG[2]

[1] Faculty of Medicine, The Chinese University of Hong Kong

[2] Gait & Motion Analysis Laboratory, Department of Rehabilitation Sciences, The Hong Kong Polytechnic University, Hong Kong

Objectives:

Kinesio Tape (KT) is widely used to manage musculoskeletal injuries and enhance sports performance. Using a specific application method, KT is claimed to be able to facilitate muscle activation and promote muscle strength. However, such claim has been challenged by previous studies, which proposed placebo could be the major attributing factor.1–3which facilitates motor unit firing, and consequently improves functional performance; however these, benefits could be due to placebo effects. This study investigated the true effects of KinTape by a deceptive, randomized, and controlled trial. Thirty healthy participants performed isokinetic testing of three taping conditions: true facilitative KinTape, sham KinTape, and no KinTape. The participants were blindfolded during the evaluation. Under the pretense of applying adhesive muscle sensors, KinTape was applied to their quadriceps in the first two conditions. Normalized peak torque, normalized total work, and time to peak torque were measured at two angular speeds (60??/s and 180??/s Hence, this study sought to compare the effect of facilitatory KT on muscle activity and performance between regular KT users and non-users.

Methods:

The study group included 27 regular KT users (who used KT at least once per week for the previous 3 months) and 33 non-KT users. A total of 60 participants performed maximal grip assessment in a randomly assigned order of two taping conditions: facilitatory KT, and no tape. Participants were made aware of each condition and the supposed effect. KT was applied to their wrist extensor muscles of the dominant forearm from the direction of origin to insertion with 125% of its original length. Within-subject comparisons of normalized root mean square of the wrist extensors electromyographic activity, maximal grip strength, and self-perceived performance were conducted across two taping conditions. Subjects were asked to record perceived performance on a scale from 0 to 10 (10 being best possible performance).

Results:

Regular KT users showed an increase in maximum grip strength with application of facilitatory KT compared to no KT condition (Cohen's d = 0.16; p = 0.030), while the non-users demonstrated similar grip strength with and without KT application (Cohen's d = 0.08, p = 0.232). No other significant differences across taping conditions in both groups regarding wrist extensor electromyographic activity (regular KT users: Cohen's d = 0.00; p = 0.992; non-KT users: Cohen's d = 0.21; p = 0.198) and self-perceived performance (regular KT users: Cohen's d = 0.14; p = 0.400; non-KT users: Cohen's d = 0.00; p = 0.876) were identified (Figure 1).

Conclusion:

Facilitatory KT promotes maximal grip strength only among regular KT users but its effect is trivial. Interestingly, such an effect is not related to any electrophysiological change in the KT applying muscle, which may indicate an indirect working mechanism leading to the increased grip strength.

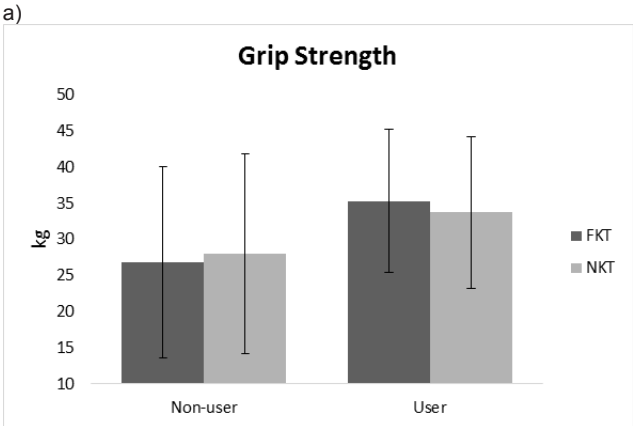
Reference:

[1] Poon KY, Li SM, Roper MG, Wong MKM, Wong O, Cheung RTH. Kinesiology tape does not facilitate muscle performance: A deceptive controlled trial. *Man Ther*. 2015;20(1):130-133. doi:10.1016/j.math.2014.07.013.

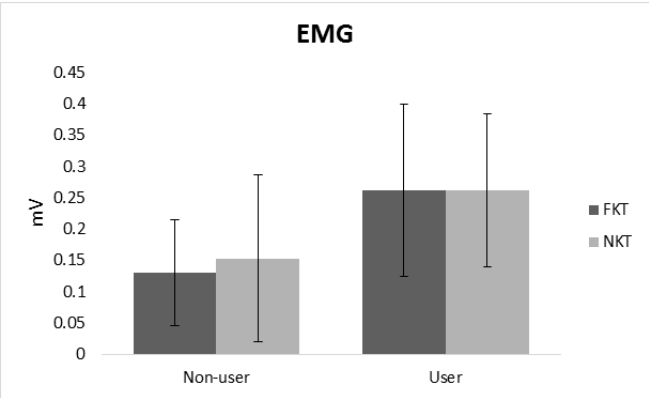
[2] Cai C, Au IPH, An W, Cheung RTH. Facilitatory and inhibitory effects of Kinesio tape: Fact or fad? *Journal of Science and Medicine in Sport*. 2014:109-112.

[3] Cheung RTH, Yau QKC, Wong K, et al. Kinesiology tape does not promote vertical jumping performance: A deceptive crossover trial. *Man Ther*. 2016;21:89-93. doi:10.1016/j.math.2015.06.001.

a)



b)



c)

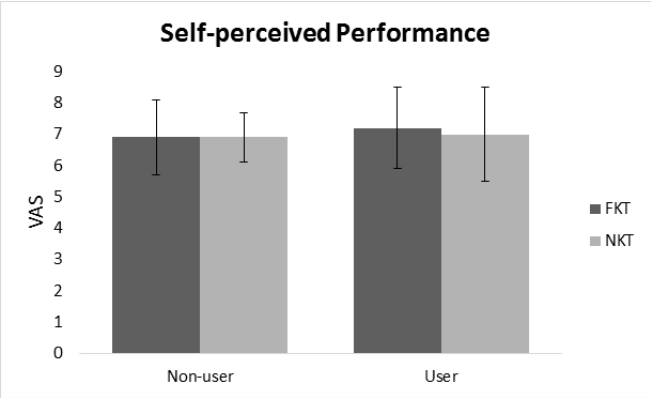


Figure1 Grip strength (a), root mean square of electromyographic activity (b), and self-perceived performance (c) of users and non-users of Kinesio Tape for Facilitatory Kinesio Tape (FKT) and No Kinesio Tape (NKT) conditions (* indicates $p < 0.05$).

The Investigation of Biomechanical Properties of Tibial Anterior Muscle of People with Chronic Stroke

Mei-zhen HUANG[1], Siu-Ngor FU[1], Leo K.S. KWOK[1], Marco Y.C. PANG[1]
[1]Department of Rehabilitation Sciences, Hong Kong Polytechnic University

Objectives:
Motor impairment (e.g., weakness, spasticity) and disuse may potentially lead to material changes and hence mechanical properties of the musculature in the paretic limbs after stroke. Weakness of the ankle dorsiflexors is a common phenomenon among individuals with stroke, and may give rise to unsuccessful foot clearance during gait. Tibialis anterior is a major ankle dorsiflexor but its mechanical properties remain understudied among people with stroke. Shear wave ultrasound elastography is an advanced technology that allows the evaluation of muscle elasticity *in vivo* non-invasively. This study aimed to compare the mechanical properties of the tibialis anterior muscle between the paretic and non-paretic sides among people with chronic stroke, using shear wave ultrasound elastography.

Methods:
Fourteen individuals with chronic stroke [6 women and 8 men; mean age: 63.5 years (SD: 6.0); mean post-stroke duration: 6.6 years (SD=4.4); median Fugl-Meyer (FM) lower limb motor score: 25 (IQR:4); median Modified Ashworth Scale (MAS): 1.5 (IQR=1)] participated in this study. Both the paretic and non-paretic sides were assessed in random order. Shear wave ultrasound elastography was used to measure shear modulus (i.e. an elastic moduli) of the tibialis anterior muscle during passive movement of the ankle from dorsiflexion (median: 15°) to plantarflexion (median: 45°) (i.e. stretching the tibialis anterior muscle). The outcome variables were: (1) slack angle: joint angle beyond which the muscle begins to develop passive elastic force upon further stretch, (2) slack elasticity: shear modulus value measured at slack angle, and (3) the rate of increase in shear modulus as the muscle is being stretched beyond the slack angle. Elasticity-angle data was curve-fitted by optimizing the slack angle, slack elasticity, and rate of increase in shear modulus within a piecewise exponential model. Paired-t tests were used to compare the slack angle, slack elasticity, and rate of increase in elasticity between the paretic and non-paretic sides.

Results:
Elasticity-angle data for both sides obtained from all participants were well fitted with the piecewise exponential model (coefficients of determination=0.957 to 0.978). On the paretic side, the mean (SD) value of the slack angle, slack elasticity, and rate of increase in shear modulus were 16.2° (7.2°), 5.7 (1.6) KPa, and 0.044 (0.012) respectively. And in the non-paretic side, the corresponding values were 11.3° (7.7°), 5.6 (1.5) KPa, and 0.036 (0.012). The rate of increase in shear modulus of the tibial anterior muscle on the paretic side was significantly greater than that on the non-paretic side (p=0.017). No significant side-to-side differences were found in the slack angle and slack elasticity (p>0.05).

Conclusion:
Our results demonstrate no significant side-to-side difference in elasticity when the tibialis anterior muscle is put in a slack position. As the muscle is being stretched beyond the slack angle, the rate of increase in shear modulus is greater on the paretic side than the non-paretic side, indicating decreased passive elastic performance of the muscle on the paretic side. The mechanical properties of the tibialis anterior muscle on the paretic side are altered, which may compromise other motor functions and should warrant further investigations.

Reference:
[1] Koo TK, Guo JY, Cohen JH, Parker KJ. Quantifying the passive stretching response of human tibialis anterior muscle using shear wave elastography. *Clin Biomech (Bristol, Avon).* 2014;29(1):33-39.
[2] Hug F, Lacourpaille L, Maisetti O, Nordez A. Slack length of gastrocnemius medialis and Achilles tendon occurs at different ankle angles. *J Biomech.* 2013;46(14):2534-2538.

Injury Patterns in Adolescent Male Football Players and Its Relationship to Sexual Maturity. A Cross-Sectional Study

Kwong-Yan CHEUNG, Siu-Wun LEUNG, Justin Wai-Yuk LEE, Patrick Shu-Hang YUNG
Department of Orthopaedics and Traumatology, The Chinese University of Hong Kong

Background:
There are strong evidences to prove that the injury rate of soccer increases with age, but limited studies show adolescent maturity has a direct relationship with injury risk in soccer.

Objectives:
This study was designed to investigate the relationship between the maturity and injuries patterns in youth soccer players.

Study Design: Cross-sectional study.

Methods:
A total of 312 Hong Kong male soccer players, ages 13-17, participated in this study. A medical doctor collected the soccer players' pubic hair to classify their maturity into stages 1 to 5 by the Tanner stages test. And, the Sports Trainers interviewed those players by the questionnaire, which included demographics information, injury types, injury locations and mechanism of injury, that had happened retrospectively during 2013-14 soccer season.

Results:
We have collected 125 injuries. Among all youth football players, 69% of them have injured at least once in the past 12 months. Eighty-two percent of injuries were found in lower extremities. The youth players who were in Tanner stages 3-5 had significantly higher injury rate than those who were in Tanner stage 1-2. The most common injury types were ligamentous sprain (45%), contusion (30%) and muscle strain (15%), which accounted for 90% for the overall injuries. The most common injury locations were the ankle (48%), the knee (14%) and the thigh (7%).

Conclusion:
Mature adolescent soccer players are more likely to experience injuries than immature players in Hong Kong.

Immediate Effects on the Changes of Morphological and Mechanical Properties of Achilles Tendon after Jogging or Race Walking

Ellis Chun-Fai LI[1]; Wai-Keung LAI[2]
[1] Department of Health Technology and Informatics, The Hong Kong Polytechnic University
[2] Department of Health Technology and Informatics, The Hong Kong Polytechnic University

Objectives:
Tendon injuries account for thirty to fifty percent of the sports injuries and Achilles Tendon (AT) injuries are statistically dominant for both general public and athletes [1]. The relationships between acute adaptations of AT after exercise and AT injuries are still poorly understood, though the tendon injury has been widely investigated biochemically, histologically and radiographically [2, 3, 4]. Insufficient *in vivo* findings of acute alterations of morphological and mechanical properties of AT are thus the research gap hindering the understanding of how immediate impacts of exercise affect the long term adaption and more importantly, AT injuries [5]. The study was conducted to quantify and compare the different impacts on thickness, CSA and elasticity of AT promptly after jogging or race walking as a foundational information for improving athletic performance, AT injury prevention and rehabilitation.

Methods:
A total of 57 young men were recruited to perform 2,000 steps of jogging and race walking in comfortable and constant pace. Jogging and race walking were performed by subjects in two separate sessions with at least 48 hours interval for returning AT to baseline structural and mechanical conditions [6] as well as giving sufficient time for subjects to rest. The mechanical (elasticity) and morphological properties (cross-sectional area (CSA) and thickness) of AT were measured sonographically before and after exercise as demonstrated in Fig. 1, 2 and 3. Data was recorded in both jpeg and DICOM formats and analyzed by SPSS (version 22.0 IBM). As the sonographic measurements are highly dependent on rater and thus it was quantified by Intraclass Correlation Coefficient (ICC).

Results:
The ATs of participants were found to be stiffened after jogging (from 415±115kPa increased to 460±102kPa, p=0.002) or race walking (from 380±123 to 435±113, p<0.001). The thicknesses of ATs were also reduced after race walking (from 0.483cm±0.0672 to 0.476cm±0.0644, p=0.009) as listed in table 1. The changes of the other measured morphological or mechanical properties of AT were statistically similar. Interestingly, it was revealed that the percentage changes of elasticity of AT are related to the baseline elasticity of AT and the tendency of altering the elasticity to around 450kPa as shown in Fig. 4. ICCs on the three measured parameters, i.e. thickness, CSA and elasticity were conducted to quantify the reliability of the rater. The scores from the ICC reflect the reliability within the rater during both the scanning and the measurements of the three parameters. The scores and 95% CI of average measures of our rater in the thickness, CSA and elasticity were 0.989 (0.882 – 0.997), 0.977 (0.943 – 0.999) and 0.993 (0.967 – 0.999) respectively.

Conclusion:
The elasticity of AT was found to be increased after either jogging or race walking. The thickness and cross-sectional area of AT were revealed to be unchanged after these two exercises except that the thickness of AT was shortened

after performing race walking. Research in this field is still in preliminary stage and more sophisticated studies on the overall impacts on musculotendinous tissues are needed to study the mechanism.

Reference:

[1] Järvinen TA, Kannus P, Maffulli N, Khan KM. Achilles tendon disorders: etiology and epidemiology. Foot and ankle clinics. 2005:10(2):255-266.

[2] Narvani AA, Thomas P, Lynn B. Key topics in sports medicine. Surgical and radiologic anatomy. London; New York: Routledge; 2006.

[3] Lorimer AV, Hume PA. Achilles Tendon Injury Risk Factors Associated with Running. Sports Med. 2014;44(10):1459-72.

[4] Wearing SC, Smeathers JE, Urry SR, Hooper SL. Strength Exercise Results in an Acute Decrease in Achilles Tendon Thickness. 2007. In proceedings Australian Conference of Science and Medicine in Sport "be-active' 07"

[5] Tardioli A, Malliaras P, Maffulli N. Immediate and short-term effects of exercise on tendon structure: biochemical, biomechanical and imaging responses. Br Med Bull. 2012:ldr052.

[6] Neves KA, Johnson AW, Hunter I, Myrer JW. Does Achilles Tendon Cross Sectional Area Differ after Downhill, Level and Uphill Running in Trained Runners? *Journal of Sports Science and Medicine*. 2014;13(4):823.

Figure 1. Positioning of the subject and the position of the rater: subjects in prone position and the ankle placed beyond the edge of the couch

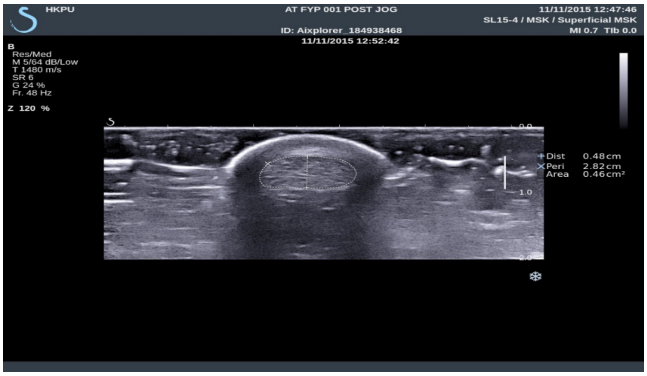


Figure 2. The sonographic image taken from transverse scan (TS) of the Achilles' Tendon (AT) for measuring the thickness and cross-sectional area of AT.

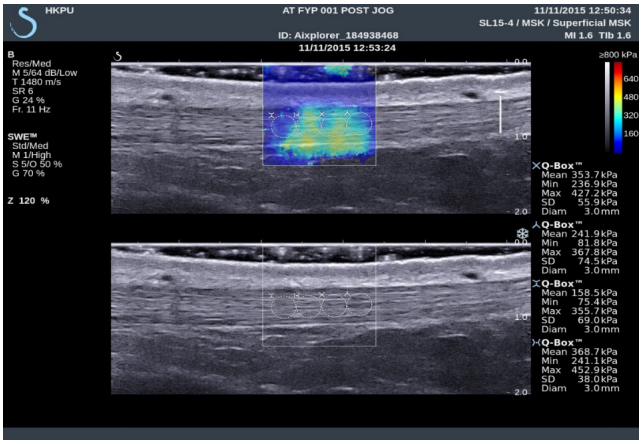


Figure 3. The elastographic image taken from longitudinal scan (LS) of the Achilles' Tendon (AT) for measuring the elasticity area of AT.

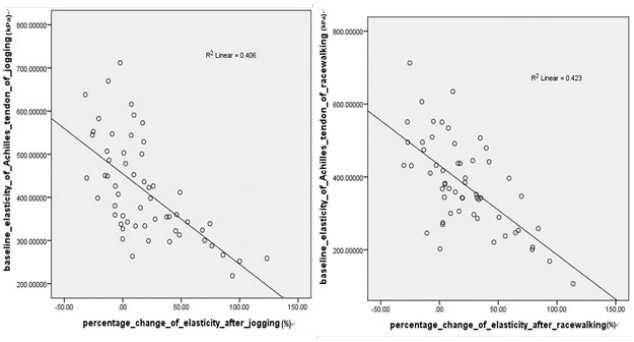


Figure 4. Relationships between the percentage changes of AT elasticity after jogging or race walking and the baseline value

Table 1: Thickness, CSA and elasticity values in pre and post-interventions

	Jogging					
	Thickness		CSA		Elasticity	
	Pre	Post	Pre	Post	Pre	Post
Mean	0.480	0.474	0.417	0.418	415	460
S.D.	0.0610	0.0602	0.0896	0.0897	115	102
	Race Walking					
	Thickness		CSA		Elasticity	
	Pre	Post	Pre	Post	Pre	Post
Mean	0.483	0.476	0.418	0.413	380	435

** Three significant figure

Original Research

Poster Presentation

1-1

Comparison of Biomechanical Parameters Between Elite and Recreational Marathon Runners from Hong Kong and Africa

Janet Han-wen ZHANG, Winko Wen-kang AN, Ivan Pui-hung AU, Zoe Yau-shan CHAN, Fannie On-yue LAU, Roy Tsz-hei CHEUNG
Gait & Motion Analysis Laboratory, Department of Rehabilitation Sciences, The Hong Kong Polytechnic University, Hong Kong

Objectives:
African long distance runners, including runners from Kenya and Ethiopia, have dominated major marathon races for the recent years. Several biomechanical parameters have been reported to correlate with better distance running performance. For instance, elite runners tend to present with longer stride [1], shorter contact time [2], and land with a midfoot (MFS) or forefoot (FFS) strike, instead of rearfoot strike (RFS) [3]midfoot strike (MFS. However, whether these biomechanical factors are innate attribute (nature) or affected by training (nurture) remain largely unknown. This case-series sought to compare these biomechanical parameters between elite and recreational marathon runners from Hong Kong and Africa.

Methods:
Four male runners were recruited in this study. One was a professional marathon runner from Kenya and his performance met the qualifying time for the 2016 Rio Olympics. The other subject was an elite marathoner from Hong Kong, who was the Hong Kong Youth Champion in 2015. The other two runners included in this study were recreational runners (weekly mileage > 10 km). One of them was from Ethiopia and the other one was from Hong Kong.

After treadmill adaptation, each runner was asked to run at four speeds (8 km/h, 10 km/h, 12 km/h and 15 km/h) on an instrumented treadmill (AMTI, Watertown, USA) in a randomized order for three minutes in each condition. The ground reaction force (GRF) data was collected at 1,000 Hz. Footstrike angle during running was monitored using a motion capturing system (Vicon, Oxford, UK) sampling at 200 Hz. Data extracted from all footfalls in the last minute of running were collected and analyzed. Stride length, cadence, contact time, footstrike angle were computed. Kinetically, body mass normalized peak GRF in vertical direction and anterior-posterior direction were also calculated and compared among the four runners.

Results:
The two elite runners appeared to demonstrate longer stride length and lower cadence compared to recreational runners (Table 1). Meanwhile, as the running speed increased, elite runners tended to remain a low cadence (173-185 steps/min) when compared to recreational runners (186-232 steps/min). Elite African runner may present with shorter contact time (0.16-0.20 s) compared to elite Hong Kong runner (0.17-0.24 s) (Table 1). In addition, African runners tend to strike the ground with non-RFS landing pattern, regardless of elite level (Figure 1). Similarly, African runners appeared to apply greater GRF in both vertical (Figure 2a) and anterior-posterior (Figure 2b) directions than Hong Kong runners.

Conclusion:
This case series hinted at a paradigm that some biomechanical parameters are innate (e.g. footstrike pattern, GRF), whereas some are training specific (e.g. temporospatial parameters). Findings of this study may provide potential strategies to enhance performance for local marathon runners.

Reference:
[1] P.T. Anderson, Sports Med. 22 (2012) 76–89.
[2] R.F. Chapman, A.S. Laymon, D.P. Wilhite, J.M. Mckenzie, D.A. Tanner, J.M. Stager, Med. Sci. Sports Exerc. 44 (2012) 917–925.
[3] H. Hasegawa, T. Yamauchi, W.J. Kraemer, J. Strength Cond. Res. Natl. Strength Cond. Assoc. 21 (2007) 888–893.

Table 1 Comparison of stride length, cadence, and contact time between the four runners (Mean ± SD)

	Speed (km/h)	Stride length (m)	Cadence (steps/min)	Contact time ($s \cdot 10^{-3}$)
Elite HK runner	8	0.71 ± 0.01	185 ± 3	236.2 ± 6.6
	10	0.93 ± 0.01	178 ± 2	206.4 ± 4.1
	12	1.11 ± 0.01	180 ± 2	189.4 ± 3.9
	15	1.37 ± 0.02	123 ± 3	169.7 ± 3.6
Elite African runner	8	0.77 ± 0.01	173 ± 3	200.0 ± 8.6
	10	0.93 ± 0.02	179 ± 3	168.8 ± 4.7
	12	1.13 ± 0.02	180 ± 3	168.5 ± 4.1
	15	1.36 ± 0.02	184 ± 3	159.1 ± 3.9
Recreational HK runner	8	0.71 ± 0.01	187 ± 3	231.6 ± 10.5
	10	0.84 ± 0.01	198 ± 3	204.7 ± 6.3
	12	0.91 ± 0.01	219 ± 3	185.4 ± 4.4
	15	1.08 ± 0.02	233 ± 4	167.7 ± 3.9
Recreational African runner	8	0.68 ± 0.02	197 ± 6	193.5 ± 6.7
	10	0.84 ± 0.03	199 ± 7	190.8 ± 7.2
	12	0.91 ± 0.03	219 ± 7	169.2 ± 5.1

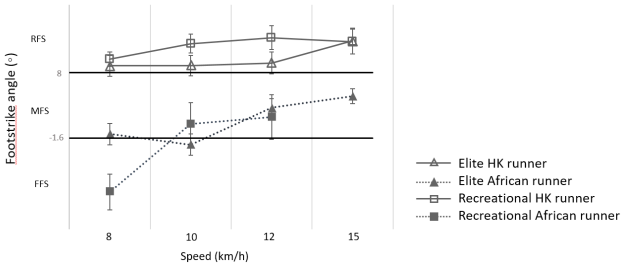


Figure 1. Footstrike angle and landing pattern of the runners

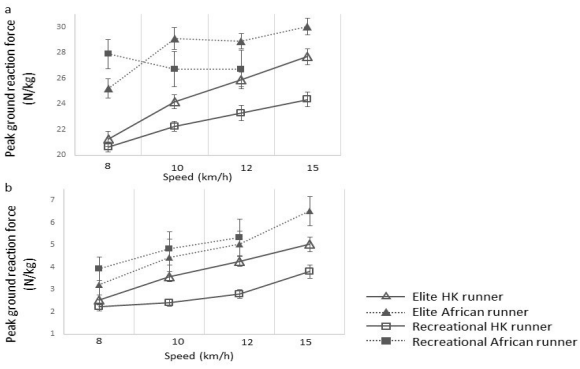


Figure 2. Peak ground reaction force in vertical (a) and anterior-posterior (b) directions during running (Normalized by body mass)

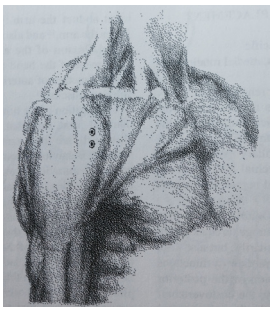
Figure 2. Peak ground reaction force in vertical (a) and anterior-posterior (b) directions during running (Normalized by body mass)

1-2

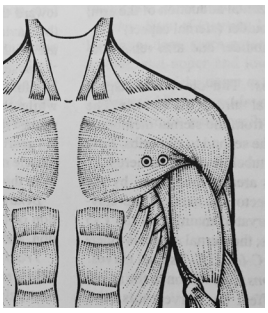
Biomechanical Analysis in Various Types of Push-Ups: Implication for Home-Based Upper Body Trainings

Christianne On-nor Anna HO, Kam-ming MOK, Patrick Shu-hang YUNG
Department of Orthopaedics and Traumatology, The Chinese University of Hong Kong

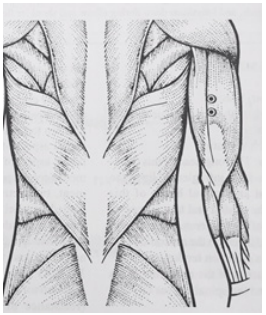
Objectives:
Push-up exercise is widely used to build strength and endurance in muscles primarily spanning over the upper body. It is a versatile exercise that has been utilised extensively in all different circumstances: outdoor or indoor, prone or standing. It is used as assessment tool by the US military army (Popovich et al., 2000; Knapik 2001), by sports specific professional athletes in baseball (Hammer C, 2009), in boxing training (Wallace and Flanagan, 1999) and in martial arts conditioning (Marshall and Murphy, 2006); well practiced by recreational fitness pursuers as well as novice in all different population groups. The objective of the study is to stipulate accurate training guidelines for home-based push-up practitioners in different variations who aim to strengthen different upper body muscle groups namely: triceps brachial (TB), pectoral major (PM) and anterior deltoid (AD) by measuring both the electromyographic (EMG) signals as well as the lengths of the moment arm (MA).



Triceps brachial (TB)



Pectoral major (PM)



Anterior deltoid (AD)

Electrodes placements on Triceps Brachial, Anterior Deltoid, and Pectoral Major
(Cram et al., 1998)

Methods:
In this study, we measured the EMG of TB, PM and AD and MA of the elbow and shoulder joints. Twelve active male subjects were selected first to perform 3 maximum voluntary contraction (MVC) trials (one per muscle), followed by performing a set of 3 push-ups in 5 exercise variants (EV): anterior neutral (AN), narrow base (NB), neutral palm (NP), posterior neutral (PN) and wide base (WB). The study procedures were approved by NTEC-CUHK Cluster REC/IRB. Data were collected using Vicon motion analysis, 3-D reflective coordinates, force platform to calculate two sets of the peak mean values of the elbow and shoulder joints MA. EMG signals collected were rectified, smoothed and digitally low-pass filtered with a 2.5 Hz cut-off frequency to normalized against respective subject's MVC trial results and finalized into 3 sets of peak mean values of TB, PM and AD in 5 EV.

Five hand positions (EV)

Hand Position	Description
Anterior Neutral (1 AN)	One full palm length of respective subject placed anteriorly to NP.
Narrow Base (2 NB)	50% of shoulder width with thumbs and indexes forming a diamond shape positioned under the sternum.
Neutral Palm (3 NP)	The proximal end of third metacarpal is directly positioned under a plumb line hung from the top edge of the deltoid.
Posterior Neutral (4 PN)	One full palm length of respective subject placed posteriorly to NP.
Wide Base (5 WB)	Doubling the distance of the palms distance by measuring the width from left to the right middle finger

Results:
TB are found being activated significantly greater in the positions AN, NB and NP when compared to WB. No significant differences found in PM and AD. There are incoherent patterns of significant difference observed when comparing the EMG signals and the MA results of TB.

Conclusion:
Significant differences found only in TB and not PM nor AD. MA lengths cannot be used as a determinant for attesting the muscle activation effectiveness. There is no sole co-relations found between EMG and MA. AN, NB and NP are the variations to work on when home-based practitioners are looking for greater TB activation in push-up exercise. All 5 EV are recommended for strengthening PM and AD in similar degree. Push-up is an effective and convenient home-based upper body strengthening exercise and should be practiced in a safe and correct manner to conform to different individual.

Reference:
[1] Popovich, R.M., Gardner, J.W., Potter, R., Knapik, J.J. and Jones, B.H., 2000. Effect of rest from running on overuse injuries in army basic training. American journal of preventive medicine, 18(3), pp.147-155.
[2] Knapik, J.J., Sharp, M.A., Canham-Chervak, M., Hauret, K., Patton, J.F. and Jones, B.H., 2001. Risk factors for training-related injuries among men and women in basic combat training. Medicine and science in sports and exercise, 33(6), pp.946-954.
[3] Hammer C., 2009. Preseason training for college baseball. J. Strength Cond. 31:79-85.
[4] Wallace, M.B. and Flanagan, S., 1999. Boxing: Resistance Training Considerations for Modifying Injury Risk. Strength & Conditioning Journal, 21(3), p.31.
[5] Marshall, P. and Murphy, B., 2006. Changes in muscle activity and perceived exertion during exercises performed on a Swiss ball. Applied physiology, nutrition, and metabolism, 31(4), pp.376-383.
[6] Cram, J.R., Kasman, G.S. and Holtz, J., 1998. Introduction to Surface Electromyography. Gaithersburg MD: Aspen Publishers Inc.

1-3

The Impact of Stroke On Bone Mass and Macrostructure Properties: A Systematic Review

Zhen-hui YANG[1,2], Marco Y.C.PANG[1]
[1] Department of Rehabilitation Sciences, The Hong Kong Polytechnic University, Hong Kong (SAR), China
[2] Department of Physical Therapy, Guangdong Provincial Work Injury Rehabilitation Hospital, Guangzhou, China

Objectives:
Secondary hemi-osteoporosis after stroke may contribute to an exaggerated risk of fragility fractures. Tackling bone health issues in the stroke population is thus a very important area. The magnitude and timing of bone loss need to be better understood before preventive or intervention strategies can be effectively implemented. The purpose of this systematic review was to synthesize the evidence related to the changes in bone health-related variables in individuals with stroke.

Methods:
A systematic search of databases was undertaken to identify all studies that measured changes in bone properties in people after stroke. Cross-sectional or longitudinal studies that used single or dual photon absorptiometry, dual energy x-ray absorptiometry, peripheral quantitative computed tomography, magnetic resonance imaging or ultrasound to measure bone properties in individuals with stroke were included. The results were pooled to determine the (1) differences in bone variables between the paretic and the non-paretic limbs, and (2) changes in bone variables over time.

Results:
A total of 72 trials were identified (56 cross-sectional, 16 longitudinal). Twenty-four studies measured bone variables in the upper limbs only, 36 studies measured the lower limbs only, and 12 studies measured both the upper and lower limbs. The results showed that (1) bone density and geometric properties in the paretic limbs were more compromised than the non-paretic limbs, (2) bone changes started during the acute stage of stroke recovery and gradually progress but started to stabilize after the first year post-stroke, and (3) the diaphyseal sites on the paretic side showed a more compromised bone status than the epiphyseal sites.

Conclusion:
The paretic upper and lower limbs sustain unfavorable bone changes after stroke, which may lead to secondary hemi-osteoporosis. Large, well-designed studies are required to further investigate the impact of stroke on bone properties amongst stroke survivors.

Reference:
[1] Jorgensen L, Jacobsen BK. Changes in muscle mass, fat mass, and bone mineral content in the legs after stroke: a 1 year prospective study. Bone 2001; 28: 655–9.
[2] Kanis J, Oden A, Johnell O. Acute and long-term increase in fracture risk after hospitalization for stroke. Stroke 2001; 32: 702–6.
[3] Pang MYC, Ashe MC, Eng JJ. Compromised bone strength index in the hemiparetic distal tibia among chronic stroke patients: the role of cardiovascular function, muscle atrophy, mobility, and spasticity. Osteoporos Int 2010; 21: 997–1007.

1-4

Effect of Inhibitory Kinesio Tape on Measured vs. Perceived Maximum Grip Strength

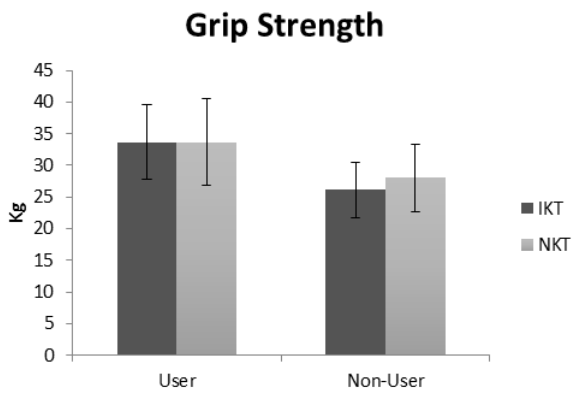
Aislinn MACPHAIL[1], Ivan Pui-hung AU[1], Mavis CHAN[1], Dominic Ngo-tung MAK[2], Winko Wen-kang AN[1], Zoe Yau-shan CHAN[1], Janet Han-wen ZHANG[1], Kenny WONG[1], Ann SO[1], Nora CHAN[1], Chris KWOK[1], Patrick LAU[1], Roy Tsz-hei CHEUNG[1]
[1] Gait & Motion Analysis Laboratory, Department of Rehabilitation Sciences, The Hong Kong Polytechnic University, Hong Kong
[2] Faculty of Medicine, The Chinese University of Hong Kong

Objectives:
The true physical effects of the commonly used sports intervention, Kinesio Tape (KT), are widely disputed. Previous studies suggest that the clinical effect of KT may mainly be attributed to placebo effects. Hence, this study sought to determine how KT applied in a supposedly inhibitory manner would affect muscle activity, measured maximal grip strength and perceived maximal grip strength in regular KT-users and non-users. We hypothesized that measured and/or perceived grip strength in KT-users would be more affected by KT applied in an inhibitory manner than in non-users, due to their preconceived notions of KT.

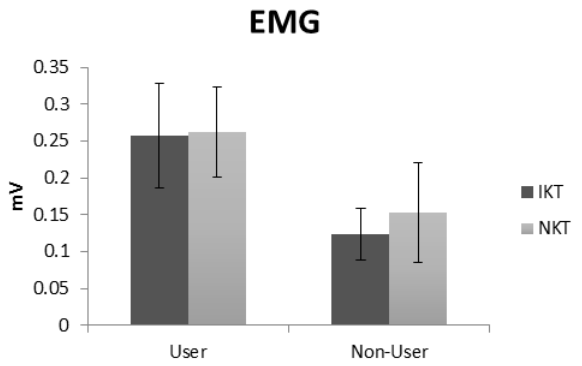
Methods:
In total, there were 60 participants in this experiment, with 27 KT users and 33 non-users. To be considered a KT-user, participants should have utilized KT at least once per week for the preceding 3 months. Non-users are participants who have never utilized KT, but may be aware of its existence. Participants performed a maximal grip assessment in a randomly assigned order of inhibitory and tape-free conditions. Participants were made aware of each condition and the supposed effect. To achieve the inhibitory condition, KT was placed across the wrist extensor muscles from insertion to origin. Within-subject comparisons of normalized root mean square of the wrist extensors electromyographic activity and maximal grip strength were conducted across the two taping conditions. Subjects were asked to record perceived performance on a scale from 0 to 10 (10 being best possible performance).

Results:
No significant difference was found in the grip strength between the two taping conditions for either KT-users (p=0.317) or non-users (p=0.294). Similarly, no significant differences were found in the EMG activity for KT-users(p=0.367) or non-users (p=0.215), or in perceived grip strength for KT-users (p=0.728) and non-users (p=0.063), in the inhibitory condition (Fig. 1).

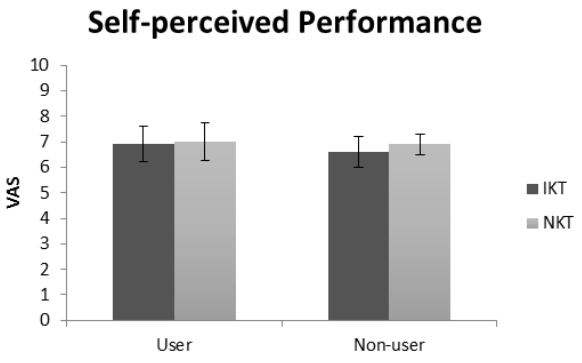
Conclusion:
Findings suggest that KT does not inhibit EMG activity, measured maximal grip strength or alter the perceived maximal grip strength in healthy participants, regardless of their preconceived notions of KT.



a.



b.



c.

Figure 1 Grip strength (a), root mean square of electromyographic activity (b), and self-perceived performance (c) of users and non-users of Kinesio Tape for Inhibitory Kinesio Tape (IKT) and No Kinesio Tape (NKT) conditions.

 # 1-5

Associations of Physical Activity, Low Back Pain and Neck Pain in Hong Kong Adolescents

Hoi-yan MOK[1]

[1]School of Public Health, University of Hong Kong

Background:

Low back pain (LBP) is a common muscle disorder that over half of the population experience once in life (1). The prevalence of it varies from 16%-22% in adolescents (1). However, the prevalence is higher in athletes (2, 3). These give us some insight that physical activities are in U-shaped relations with LBP (4). However, there is few studies investigate the association between LBP and non-exercise physical activity (NEPA), e.g. moving around.

Neck pain is another common musculoskeletal pain and its prevalence is 4.9%-45% (5-7) in adolescents. Epidemiology studies showed inconsistent results between physical activity and neck pain. Some suggested high-level physical exercises were associated with less neck pain symptoms (8), while more studies suggested that there is no association between physical activity and neck pain (9).

Objectives:

To investigate the association of physical activity, NEPA, low back pain and neck pain.

Methods:

We analyzed data from Hong Kong Student Obesity Surveillance (HKSOS) project, which included 34678 secondary school students from 42 randomly selected schools. Students were asked if they had experienced LBP (yes or no) or neck pain (yes or no) in the last month. Also, the time they spent on physical activity and NEPA on weekdays and holiday were asked. The number of hours per day was categorized as 1/2 or less (inactive), and equal to 1 or more (active). Potential confounders, e.g. age, sex and perceived economic status (low, medium, wealthy) were also recorded. Logistic regression was used and adjusted odds ratios (AORs) were reported after adjust for potential confounders.

Results:

After data cleaning, the prevalence of low back pain was 9.6% (95% CI 9.3%-9.9%), while that of neck pain is 8% (95% CI 7.7%-8.3%). Females have higher prevalence of LBP and neck pain than males (75.7% vs 24.3% and 72.4% vs 27.6%) (P<0.001). Nearly half of the students were physical active (46.7%) on weekdays, whereas more students were active on holiday (63.6%). More students were active in NEPA, in which 65.2% active on weekdays and 74.4% active on holiday. On weekdays, the AORs (95% CI) of LBP were 0.73 (0.68-0.80) for active in physical activity. The corresponding AORs (95% CI) were 0.89 (0.82-0.97) for active in NEPA. Similarly, the result was consistent with those on holiday. The AORs (95% CI) of LBP were 0.79 (0.73-0.86) for active in physical activity, whereas it were 0.91 (0.83-1.00) for NEPA. On the other hand, physical activity was associated with decreased risk of neck pain 0.76 (0.69-0.83) on weekdays. However, NEPA was not significantly associated with neck pain. On holiday, physical activity was associated with decreased risk of neck pain 0.80 (0.73-0.87). However, similarly, there is no significant association observed between NEPA and neck pain.

Conclusion:
The prevalence of low back pain was 9.6% and it was significantly associated with physical activity and NEAP on weekdays and holiday. On the other hand, the prevalence of neck pain was 8.0%. It was significantly associated with physical activity but not NEAP.

Funding: University Research Committee, Strategic Research Theme on Public Health, University of Hong Kong

Reference:

[1] Jones G, Macfarlane G. Epidemiology of low back pain in children and adolescents. Archives of disease in childhood. 2005;90(3):312-6.
[2] Ng L, Perich D, Burnett A, Campbell A, O'Sullivan P. Self-reported prevalence, pain intensity and risk factors of low back pain in adolescent rowers. Journal of Science and Medicine in Sport. 2014;17(3):266-70.
[3] Schmidt C, Zwingenberger S, Walther A, Reuter U, Kasten P, Seifert J, et al. Prevalence of low back pain in adolescent athletes–an epidemiological investigation. International journal of sports medicine. 2014;35(08):684-9
[4] Heneweer H, Vanhees L, Picavet HSJ. Physical activity and low back pain: a U-shaped relation? Pain. 2009;143(1):21-5.
[5] Hakala P, Rimpelä A, Salminen JJ, Virtanen SM, Rimpelä M. Back, neck, and shoulder pain in Finnish adolescents: national cross sectional surveys. Bmj. 2002;325(7367):743.
[6] Wedderkopp N, Leboeuf-Yde C, Andersen LB, Froberg K, Hansen HS. Back pain reporting pattern in a Danish population-based sample of children and adolescents. Spine. 2001;26(17):1879-83.
[7] Feldman DE, Shrier I, Rossignol M, Abenhaim L. Risk factors for the development of neck and upper limb pain in adolescents. Spine. 2002;27(5):523-8.
[8] van den Heuvel SG, Heinrich J, Jans M, Van der Beek A, Bongers P. The effect of physical activity in leisure time on neck and upper limb symptoms. Preventive medicine. 2005;41(1):260-7.
[9] Sitthipornvorakul E, Janwantanakul P, Purepong N, Pensri P, van der Beek AJ. The association between physical activity and neck and low back pain: a systematic review. European Spine Journal. 2011;20(5):677-89.

 # 1-6

The Effect of Aerobic Exercise Combined with Garcinia Cambogia Extract on the Body Fat and Blood Lipids in Rats

Zheng ZHANG
Department of Public Health, The University of Hong Kong

Objective:
To examine effects of aerobic endurance exercise combined with supplement of garcinia cambogia extract on body fat and blood lipids in high-fat-diet rat.

Methods:
48 male SD rats were randomly divided into six groups. Lipid energy percent of high fat diet was 65% ,and the appropriate daily dose of garcinia cambogia extract in literature was 200mg/100g weight. At 14:00 - 16:00 rats of corresponding group were orally gavaged;other groups were fed by the appropriate volume of distilled water weight. Treadmill running, 6d / w, 60min / d, 15m/min, a total of 4 weeks. In the end, fasting 12h and weigh the rats, with 2% sodium pentobarbital anesthesia, taking peripheral adipose of kidney and testis, the abdominal aorta collected blood samples to measure the index.

Result:
A high-fat group by the single intervention to Garcinia cambogia extract and by the intervention to Garcinia cambogia extract combined with aerobic exercise, the weight of peripheral adipose of kidney and testis decreases, TG decreased, TC falling, rising Apo-A1 are extremely significant difference ($P < 0.01$), and dual intervention to the first four indicate superimposed enhancement, but the weakening effect of Apo-A1 in the rising index ($P < 0.05$). Dual intervention group set to rise in the LDL targets $P < 0.05$, and a single intervention group did not show.

Conclusion:
Aerobic exercise combined with Garcinia cambogia extract had a significant effect on the on body fat and blood lipids in high-fat-diet rat.

Reference:

[1] Roy S, Shah H, Rink C, et al. Transcriptome of primary adipocytes from obese women in response to a novel hydroxycitric acid-based dietary supplement[J]. DNA and cell biology, 2007, 26(9): 627-639.
[2] Roongpisuthipong C, Kantawan R, Roongpisuthipong W. Reduction of adipose tissue and body weight: effect of water soluble calcium hydroxycitrate in Garcinia atroviridis on the short term treatment of obese women in Thailand[J]. Asia Pacific journal of clinical nutrition, 2007, 16(1).
[3] Roy S, Shah H, Rink C, et al. Transcriptome of primary adipocytes from obese women in response to a novel hydroxycitric acid-based dietary supplement[J]. DNA and cell biology, 2007, 26(9): 627-639.
[4] Saito M, Ueno M, Ogino S, et al. High dose of<i> Garcinia cambogia<i> is effective in suppressing fat accumulation in developing male Zucker obese rats, but highly toxic to the testis[J]. Food and chemical toxicology, 2005, 43(3): 411-419.
[5] Vasques C A R, Rossetto S, Halmenschlager G, et al. Evaluation of the pharmacotherapeutic efficacy of Garcinia cambogia plus Amorphophallus konjac for the treatment of obesity[J]. Phytotherapy research, 2008, 22(9): 1135-1140.
[6] Colvin PL , Moriguchie, Barrett H , et al. Production rate determines plasma concentration of large high density lipoprotein in non –human primates [J] . J Lipid Res , 1998 , 39 :2 076-085
[7] Colvin , Morigueh E , Barrett PHR, et al. Small HDL particles containing 2 apoA-I molecules are precursors *in vivo* to medium and large HDL containing 3 and 4 apoA -I molecule in nonhuman primates [J] . J Lipid Res, 1999 , 40 :1 782 -792.

Key words: Garcinia cambogia extract; fat diet; aerobic exercise; lose weight

1-7

Effects of Deceptive Footwear Condition on Subjective Comfort and Joint Kinematics in Runners

Zoe Yau-shan CHAN, Janet Han-wen ZHANG, Ivan Pui-hung AU, Winko Wen-kang AN, Roy Tsz-hei CHEUNG
Gait & Motion Analysis Laboratory, Department of Rehabilitation Sciences, The Hong Kong Polytechnic University, Hong Kong

Objectives:
Comfort was considered one of the key criteria for runners to select their shoes and better comfort level could enhance their running performance [1]. Interestingly, previous studies suggested that subjective comfort was not associated with cost [2] or cushioning performance of the shoes [3]. In addition, shoe fit and distribution of plantar pressure during running may not consistently affect comfort [1,2]. Therefore, it is highly possible that subjective comfort is subject to bias. Potential placebo effect of a physical intervention has been successfully controlled in recent clinical studies [4]. Hence, this study sought to examine the effects of deceptive footwear conditions on subjective comfort and lower limb kinematics in runners.

Methods:
Ten regular runners (5 males and 5 females; >8 km/week for the last six months) were recruited from local running clubs. They were told to have running tests in two footwear conditions (Shoe A and Shoe B) in a randomized order. In order to eliminate subjective perception of the footwear appearance, participants were blindfolded during shoe fitting and during the running test. We explicitly informed all participants that Shoe B was much more expensive than Shoe A, and Shoe B was a latest model designed to maximize comfort. Indeed, the same pair of running shoes (ARHL002, Li Ning, Beijing, China) were used as both Shoe A and B. After attachment of reflective markers onto specific bony landmarks of the left lower extremities [5], participants were asked to run on an instrumented treadmill (AMTI, Watertown, MA, USA) at a self-paced speed for two 5-minute trials for each deceptive shoe condition. Two trials were separated by a 15-minute washout period. Kinematics data was sampled at 200 Hz using an 8-camera motion capturing system (VICON, Oxford, UK). Data from the last 20 footfalls were analyzed. Immediately after a running trial, runners were asked to evaluate the comfort level of the test shoes using a validated instrument [6].

Results:
Participants reported significant greater comfort level in Shoe B than Shoe A ($p = 0.016$, Cohen's $d = 0.788$; Table 1). Joint kinematics of the ankle, knee, and hip on sagittal, frontal, and transverse plane were comparable between two deceptive shoe conditions (Table 1 and Figure 1).

Conclusion:
Deceived runners may have incorrect perception on the subjective shoe comfort, even the running kinematics remains unchanged. Runners should be cautious when assessing potentially misleading descriptions and claims. The choice of running shoes should not be based entirely upon self-perceived comfort but a wider range of comparable factors including biomechanical variables and material properties.

Reference:

[1] J.E. Miller, B.M. Nigg, W. Liu, D.J. Stefanyshyn, M.A. Nurse, Foot Ankle Int 21 (2000) 759–767.
[2] R. Clinghan, G.P. Arnold, T.S. Drew, L.A. Cochrane, R.J. Abboud, British Journal of Sports Medicine 42 (2008) 189–193.
[3] R.C. Dinato, A.P. Ribeiro, M.K. Butugan, I.L.R. Pereira, A.N. Onodera, I.C.N. Sacco, Journal of Science and Medicine in Sport 18 (2015) 93–97.
[4] C. Cai, I.P.H. Au, W. An, R.T.H. Cheung, J Sci Med Sport 19 (2016) 109–112.
[5] M.P. Kadaba, H.K. Ramakrishnan, M.E. Wootten, J. Gainey, G. Gorton, G.V. Cochran, J. Orthop. Res. 7 (1989) 849–860.
[6] A. Mündermann, B.M. Nigg, D.J. Stefanyshyn, R.N. Humble, Gait Posture 16 (2002) 38–45.

Table 1. Subjective comfort and lower limb kinematics (means ± SD) between two deceptive shoe conditions

Variable	Shoe A	Shoe B	*P*	Effect size
Overall Comfort (%)+	60.6 ± 10.8	70.7 ± 10.1	0.016*	0.788
At Initial Contact				
Ankle Joint Angle (°)	86.5 ± 7.2	85.6 ± 7.0	0.413	0.272
Knee Joint Angle (°)	17.2 ± 6.0	16.8 ± 5.1	0.726	0.115
Peak Knee Flexion Angle				
During Stance (°)	41.6 ± 8.0	41.0 ± 5.4	0.635	0.155
During Swing (°)	80.3 ± 14.7	81.4 ± 13.3	0.390	0.286

+Overall comfort was measured as a scale from 0-100%, where 100% indicated best comfort level.

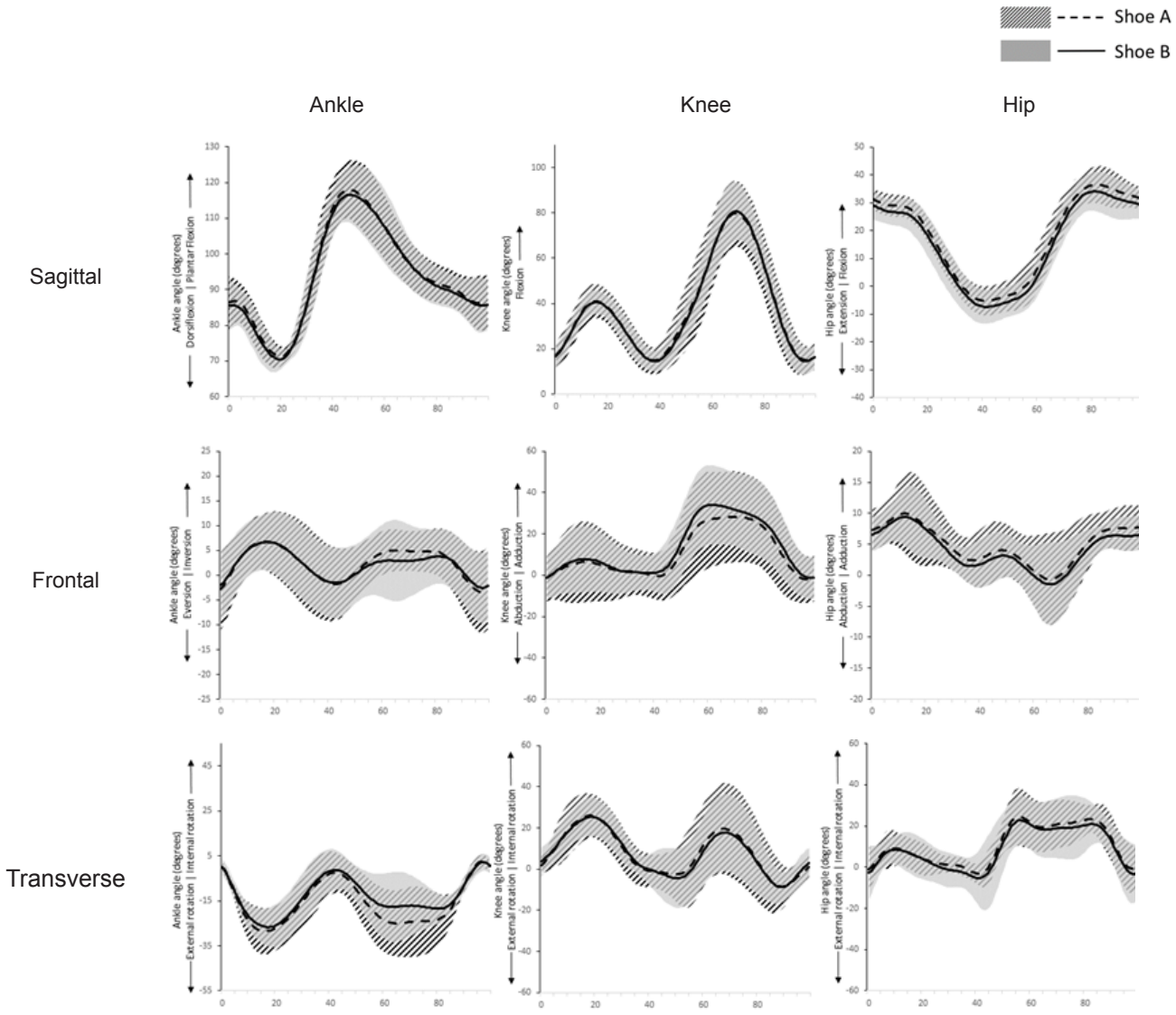


Figure 1. Angular displacement (Mean and SD) of the ankle, knee and hip joints in a running gait cycle

1-8

A Comparison of Muscle Coordination and Stroke Kinematics between Stationary and Dynamic Indoor Rowing Machines in Lightweight Rowers

Ming-hang CHEUNG, Kenneth Chik-chi CHENG
Department of Sports Science and Physical Education, The Chinese University of Hong Kong

Ergometers have been widely used as training and testing alternatives for on-water rowing. Indoor rowing itself is an increasingly popular sport for people of all ages and athletic ability. There were different brands and designs of indoor rowing machines available for testing and training, yet there was no study comparing the traditional stationary design and the recently introduced dynamic design.

Objectives:
The aim of the study was to compare the total drive time, drive-to-recovery ratio and range of motion of joints; and the lower limb and back muscles' recruitment pattern among lightweight rowers on Concept II Stationary ergometer (C2S), Concept II Dynamic ergometer (C2D) and Oartech ergometer (OAR).

Methods:
Twelve male lightweight rowers (age = 21.83 ± 1.85years, height = 175.58 ± 6.07cm, weight = 71.83 ± 4.63kg) performed a total of six trials of 30 strokes rowing (two designated stroke rates by three ergometers) in the same day. A GoPro action camera was used to record the motion of rowers. Hip, knee and ankle joint kinematics data were obtained by frame-by-frame analysis. The activities of *vastus lateralis, vastus medialis, bicep femoris, erector spinae, tibialis anterior* and *gastrocnemius lateralis* were recorded from the right side using surface electromyography for offline analysis. The EMG data from the middle 10 consecutive strokes were extracted, filtered and normalized at each 10% segment of the stroke cycle. Two way repeated measures ANOVA were conducted and significant interactions were tested using Bonferroni adjustment for post-hoc pairwise comparison.

Results:
Significant larger mean drive time (p<0.05 for C2D; p<0.01 for OAR) and mean drive-to-recovery ratio (p<0.05 for C2D) were observed for the C2S across both stroke rates. The effect of an increased stroke rate on knee and ankle was decreased range of motion (both p<0.01). The overall muscle activities were statistically insignificant, yet the total muscle activation pattern were different across the ergometers designs. Significantly higher *tibialis anterior* recruitment was observed at 40-70% of a stroke (p<0.01) on the C2D. The mean *erector spinae* activity of rowing on the C2S was significantly higher at 40-70% of the stroke when compared to OAR (p<0.05) and C2D (p<0.05) at a higher stroke rate.

Conclusion:
Our finding showed the stationary ergometer would induce a different stroke profile and a large lower limb and lower back muscle activities in the middle part of the stroke, yet the total muscle load seemed to be similar across the machines. The dynamic models seem to provide a better mechanical advantage and may imply a lower risk of injury over the stationary model in ergometer training. Rowers can choose to train and test on a statistic or a dynamic ergometer to produce similar overall muscle load, but they should be aware of the difference in muscle recruitment strategies and amplitudes at different stroke rates. Further investigation on the stress to lower back and lower limbs should be conducted between statistic and dynamic ergometers, as well as on-water rowing to provide more information on rowing machine selection for landing training.

Reference:
[1] Bazzucchi, I., Sbriccoli, P., Nicolò, A., Passerini, A., Quinzi, F., Felici, F., & Sacchetti, M. (2013). Cardio- respiratory and electromyographic responses to ergometer and on- water rowing in elite rowers. *European Journal of Applied Physiology, 113*(5), 1271-1277. doi:10.1007/s00421-012-2550-2
[2] Elliott, B., Lyttle, A., & Birkett, O. (2002). The RowPerfect ergometer: A training aid for on- water single scull rowing. *Sports Biomechanics, 1*(2), 123-134.
[3] Fleming, N., Donne, B., & Mahony, N. (2014). A comparison of electromyography and stroke kinematics during ergometer and on- water rowing. *Journal of Sports Sciences, 32*(12), 1127-1138. doi:10.1080/02640414.2014.886128
[4] Greene, A. J., Sinclair, P. J., Dickson, M. H., Colloud, F., & Smith, R. M. (2013). The effect of ergometer design on rowing stroke mechanics. *Scandinavian Journal of Medicine & Science in Sports, 23*(4), 468-477. doi:10.1111/j.1600-0838.2011.01404.x
[5] Holsgaard- Larsen, A., & Jensen, K. (2010). Ergometer rowing with and without slides. *International Journal of Sports Medicine, 31*(12), 870-874. doi:10.1055/s-0030-1265148
[6] Janshen, L., Janshen, L., Tidow, G., & Mattes, K. (2009). Muscular coordination of the lower extremities of oarsmen during ergometer rowing. *Journal of Applied Biomechanics, 25*(2), 156-164.
[7] Nowicky, A. V., Burdett, R., Horne, S. (2005). The impact of ergometer design on hip and trunk muscle activity patterns in elite rowers: An electromyographic assessment. *Journal of Sports Science and Medicine, 4*(1), 18-28.
[8] Vinther, A., Alkjær, T., Kanstrup, I. L., Zerahn, B., Ekdahl, C., Jensen, K., Holsgaard larsen, A., & Aagaard, P. (2013). Slide based ergometer rowing: Effects on force production and neuromuscular activity. *Scandinavian Journal of Medicine & Science in Sports, 23*(5), 635-644. doi:10.1111/j.1600-0838.2011.01441.x
[9] Wilson, F., Gissane, C., Gormley, J., & Simms, C. (2013). Sagittal plane motion of the lumbar spine during ergometer and single scull rowing. *Sports Biomechanics, 12*(2), 132-142. doi:10.1080/14763141.2012.726640

1-9

Water-based and Land-based Recovery Exercise on Circulatory Response and Muscle Injury after Prolonged Eccentric Exercise

Edwin Chun-yip CHIN[1], Feng-hua SUN[1], Steve Chung-nam LAI[1], Sau-fung TSANG[1], Sam Ho-ngai CHUNG[1], Yik-long WONG[1], Navjot SRAN[1], Kwok-keung FUNG[1]

[1] Department of Health and Physical Education, The Education University of Hong Kong

The purpose of this study is to examine physiological responses of aqua recovery exercise after eccentric exercise. Sixteen university sport team male athletes were voluntarily recruited. Using randomized repeated crossover study design, participants jogged in water and on treadmill after five bouts of eight minutes downhill running (-10%) at heart rate equal to 80% VO2max. Heart rate, blood pressure, muscle tenderness, muscle swelling, skin temperature, creatine kinase were measured before and after (i.e. immediately, 24 hours and 48 hours) intervention. Several between group differences were discovered: 1) lower heart rate at immediately after aqua recovery ($p = 0.016$, $\eta 2 = 0.331$); 2) lower systolic blood pressure at 24 hours after aqua recovery ($p = 0.024$, $\eta 2 = 0.650$); 3) less muscle tenderness in hamstring at 24 hours after aqua recovery ($p = 0.036$, $\eta 2 = 0.262$); 4) fewer skin temperature in lower limb joints at immediately after aqua recovery (knee: $p = 0.027$, $\eta 2 = 0.285$; ankle: $p = 0.003$, $\eta 2 = 0.451$). To conclude, in-water jogging may diminish cardiac loading and ease muscle tenderness during post-exercise recovery, also provide cooling effect to lower limbs joints.

Keywords: Active Recovery Exercise, Eccentric Exercise, Delayed-Onset Muscle Soreness

Project Proposal

Poster Presentation

2-01

Effects of a Visual-feedback Gait Retraining on Landing Pattern Transition in Rear-foot Strike Runners

Zoe Yau-shan CHAN, Janet Han-wen ZHANG, Ivan Pui-hung AU, Winko Wen-kang AN, Roy Tsz-hei CHEUNG
Gait & Motion Analysis Laboratory, Department of Rehabilitation Sciences, The Hong Kong Polytechnic University, Hong Kong

Objective:
Biomechanical parameters such as vertical loading rate [1,2] and landing pattern [3] have demonstrated significant associations with running-related injuries. A rearfoot strike (RFS) has been reported to result in a higher vertical loading rate as compared to midfoot strike (MFS) and forefoot strike (FFS) [4]. A previous case study using audio feedback gait retraining has successfully reduced the rate of RFS by 90% in runners with patellofemoral pain [2]. However, aggressive attempts of FFS had been reported to associate with delayed onset muscular soreness [5] and Achilles tendonitis [6]. Currently, there is no evidence to support an effective and safe gait retraining for landing pattern transition. Hence, this study aims to study the immediate and short term (1-month) effect of a visual-feedback gait retraining program to achieve MFS in a group of runners with RFS.

Methods:
Based on data of the primary variable of interest (vertical average loading rate) from a previous study [7], with an a priori power analysis with α=0.05, β=0.2, and attrition rate of 20%, 15 regular runners who habitually adopt RFS will be recruited from local running clubs. At the baseline evaluation, participants will be asked to run on an instrumented treadmill (AMTI, Watertown, MA, USA) at their self-paced speed for four minutes. Kinetics and lower limb kinematics data will be sampled using the instrumented treadmill and an 8-camera motion capturing system (VICON, Oxford, UK) respectively during the last minute of running. The foot strike angle (FSA) will be calculated as the angle of the foot with respect to the ground in the sagittal plane [8]. Loading rate will be the slope of the line through the 20% and 80% point of the vertical impact peak obtained from the vertical ground reaction force. Vertical average loading rate (VALR) and vertical instantaneous loading rate (VILR) will be obtained by the method described in a previous study [1] and they will be normalized with body mass.

All the runners will then be invited for a two-week gait retraining program [1]. During the training, FSA of the right foot will be computed using customized MATLAB codes (The MathWorks, Inc, Natick, MA, USA) and real-time footstrike information will be displayed on a monitor placed in front of the treadmill (Figure 1). In order to promote motor learning, the biofeedback will be gradually removed across the two-week program. In addition, they will be instructed to run with the newly learnt gait after the training. All the runners will be reassessed immediately after and one month after the training and the evaluation procedures will be identical to the baseline assessment.

Within-subject comparisons of the FSA, VALR and VILR will be conducted across time using repeated measures of ANOVA. All statistical analyses will be performed using SPSS version 20 (SPSS Inc., Chicago, IL, USA) and global alpha will be set at 0.05.

Potential Implications:
Landing pattern modification is popular among coaches and runners possibly because of its potential health benefit and effect in performance enhancement. With advancement in technology, running related biomechanical parameters, including foot strike information, can be provided to runners, in real-time. With such information, systematic modification of landing pattern, similar to other gait retraining programs, would be highly possible. This study can be impactful in providing a concrete, effective, and safe protocol for landing pattern transition in the rapid growing running population.

Reference:
[1] H.P. Crowell, I.S. Davis, Clinical Biomechanics 26 (2011) 78–83.
[2] R.T.H. Cheung, I.S. Davis, Journal of Orthopaedic & Sports Physical Therapy 41 (2011) 914–919.
[3] A.I. Daoud, G.J. Geissler, F. Wang, J. Saretsky, Y.A. Daoud, D.E. Lieberman, Medicine & Science in Sports & Exercise 44 (2012) 1325–1334.
[4] A.R. Altman, I.S. Davis, Current Sports Medicine Reports 11 (2012) 244–250.
[5] M. Giandolini, P.J. Arnal, G.Y. Millet, N. Peyrot, P. Samozino, B. Dubois, J.-B. Morin, European Journal of Applied Physiology 113 (2013) 599–609.
[6] J. Sinclair, Clinical Biomechanics 29 (2014) 395–399.
[7] B. Noehren, J. Scholz, I. Davis, Br J Sports Med 45 (2011) 691–696.
[8] A.R. Altman, I.S. Davis, Gait & Posture 35 (2012) 298–300.

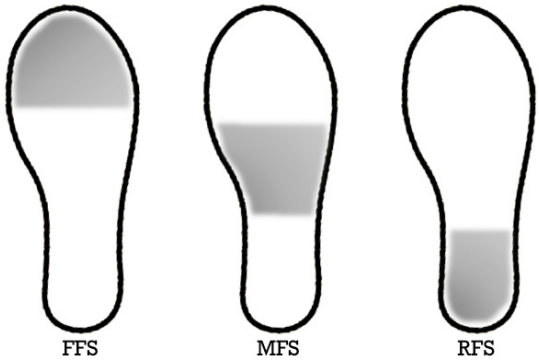


Figure 1. Visual feedback for 1) FSA below -1.6 o (left) 2) FSA between -1.6 o and 8 o (middle) 3) FSA greater than 8o (right). FFS = Forefoot strike; MFS = Midfoot strike; RFS = Rearfoot strike

2-02

Alterations in Patellofemoral Kinematics Following Anterior Cruciate Ligament Deficiency and Reconstruction

Wen-han HUANG[1], Kam-ming MOK[1]; Yan-chi CHAN[1], Patrick Shu-hang YUNG[1]
[1]Department of O&T, The Chinese University of Hong Kong

Objectives:
The prevalence of Knee osteoarthritis (including tibiofemoral and patellofemoral joint) after ACL reconstruction is high. This study is to quantificationally determine the relationship between biomechanics following anterior cruciate ligament (ACL) rupture and reconstruction and the development of patellofemoral OA after ACL deficiency and reconstruction.

Methods:
Eighteen fresh-frozen human cadaveric knees from donors will be loaded using a robotic manipulator to simulate knee joint motion from extension to high flexion. Motions will be recorded with the ACL intact (group 1, 6 knees), with the ACL sectioned (group 2, 6 knees), and with ACL reconstruction (group 3, 6 knees). Patellofemoral kinematics, knee abduction moment, contact pressure and area will be evaluated in the whole procedure from extension to high flexion (150°). Sensors will be used to measure contact pressure and contact area between femur and patella. Flexion angles will be divided into three levels: lower flexion angel:0°~30°; Middle flexion angle: 31°~90°; higher flexion angle: 91°~150°. We compare the difference of patellofemoral kinematics, knee abduction moment, contact pressure/area in different flexion levels in the three groups that have different ACL status. Repeated measures ANOVA will be used to analyze the difference among groups.

Potential Implications:
The patellofemoral compartment should be included as part routine radiographic examinations following ACL reconstruction. Clinicians should consider the patellofemoral joint during postoperative rehabilitation in an attempt to address long-term symptoms and degenerative joint disease. Particular clinical attention should be paid to optimize patellofemoral function in individuals with patellofemoral chondral lesions observed at the time of ACLR.

Reference:
[1] Claes S, Hermie L, Verdonk R, Bellemans J, Verdonk P. Is osteoarthritis an inevitable consequence of anterior cruciate ligament reconstruction? A meta-analysis. Knee Surg Sports Traumatol Arthrosc. 2013;21(9):1967–1976.
[2] Van de Velde SK, Gill TJ, DeFrate LE, et al. The effect of anterior cruciate ligament deficiency and reconstruction on the patellofemoral joint. Am J Sports Med 2008;36:1150–9.
[3] Van Meer BL, Meuffels DE, van Eijsden WA, et al. Which determinants predict tibiofemoral and patellofemoral osteoarthritis after anterior cruciate ligament injury? A systematic review. Br J Sports Med. 201549(15):975-83.
[4] Culvenor A G, Lai C C H, Gabbe B J, et al. Patellofemoral osteoarthritis is prevalent and associated with worse symptoms and function after hamstring tendon autograft ACL reconstruction[J]. British journal of sports medicine, 2014, 48(6): 435-439.

2-03

Physical Literacy: A Survey of Hong Kong Universities Students

Suet-ting LAM, Raymond Kim-wai SUM
Department of Sports Science and Physical Education, The Chinese University of Hong Kong

Objectives:
Physical literacy has become a global topic of interest in the areas of health and physical education (Whitehead, 2013). Yet, different physical education programs delivered to university students that impacted on their physical literacy have not been explored and the keys should be focused (Mohammed, 2016). The proposed study will therefore aim to examine Hong Kong university students' perceived physical literacy under different physical education programs delivery modes (required with credit bearing, required without credit bearing and not required).

Methods:
The proposed study will measure perceived physical literacy of students among 8 universities under the University Grants Committee (UGC). It is estimated 2000 students will participate in this study. It is essential that students should have experienced physical education program upon graduation (Kwan et al., 2012; Sigmundova et al., 2013), however, the steepest decline of physical activity level occurs at the time of university admission and continues to decline with increasing age. Therefore, sophomore and senior will be targeted and freshmen will be excluded. The Perceived Physical Literacy Instrument (PPLI) (SUM et al., 2016) for adolescents, a self-report assessment will be used to quantify the measured perceived physical literacy. Data collected will be analyzed by using SPSS Statistics software.

Potential Implications:
Firstly, as there is no recent literature that studies the perceived physical literacy in university students, this study will be the first to investigate on Hong Kong university students' perceived physical literacy. Also, results will provide directions and information for further studies on the effectiveness of physical education programs on Hong Kong university students' perceived physical literacy. Moreover, with the increased awareness of physical literacy levels, this study in turn has the potential to improve the quality of individuals' healthy active lifestyle.

Reference:
[1] Kwan, M.Y., Cairney, J., Faulkner, G.E., & Pullenavegum, E.E. (2012). Physical activity and other health-risk behaviors during the transition into adulthood: A longitudinal cohort study, American Journal of Preventive Medicine, 42(1),14-20. Doi:10.1016/j.amepre.2011.08.026
[2] Mohammed, M. H. (2016). Attitudes of Male University Students towards a Physical Education Curriculum that Includes Health Education. Indian Journal of Science and Technology, 9(36). Doi:10.17485/ijst/2016/v9i36/95009
[3] Sigmundova, D., Chmelik, F., Sigmund, E., Feltlova, D., & Fromel, K. (2013). Physical activity in the lifestyle of Czech university students: Meeting health recommendations, European Journal of Sport Science, 13:6, 744-750. Doi:10.1080/17461.2013.776638
[4] Sum, R. K. W., Ha, A. S. C., Cheng, C. F., Chung, P. K., Yiu, K. T. C., Kuo, C. C., Yu, C. K., & Wang, F. J. 2016). Construction and Validation of a Perceived Physical Literacy Instrument for Physical Education Teachers. PLoS ONE 11((5) e0155610. Doi:10.1371/journal.pone.0155610
[5] Whitehead, M. (2013). What is physical literacy and how does it impact on physical education. *Debates in Physical Education*, 37-52.

2-04

Investigation of the Gaze Behavior during Walking in Community-dwelling Elderly People: Implication for Fall Rehabilitation

Toby Chi-to MAK[1], Thomson Wai-lung WONG[1]
[1]School of Public Health, Li Ka Shing Faculty of Medicine, The University of Hong Kong

Objectives:
The current proposed exploratory study attempts to evaluate the strategies that elderly fallers and non-fallers use to actively scan visually through the environment under different circumstances. We hypothesize that elderly fallers and non-fallers employ different visual search strategies during walking movements and obstacle challenges. The aim of this study will be, therefore, to identify visual search strategies on elderly fallers and non-fallers, and to distinguish the differences among them.

Methods:
Fifty older adults categorized as fallers and fifty older adults categorized as non-fallers will be recruited in Hong Kong for the study. Each participant will have to complete 5 trials. For each trial, participant will be asked to walk along a walkway of total 6m and place his foot within stepping targets. The stepping targets with border of 40mm x 40mm will be made from light-weight packaging foam with elevated edges (Young & Hollands, 2012). Participant will be instructed to place his feet ‘‘as precise as he/she could into the centre of the target’’ for each of the stepping targets.

Potential Implications:
The expected outcome will be that elderly fallers and non-fallers will employ different visual search strategies during walking movements and obstacle challenges. The anticipated value of the result will be that the visual search strategies from non-fallers might be better than that from elderly fallers leading to better balancing or higher foot placement accuracy etc. It will be of paramount significance on elderly fallers if we could identify visual search strategies on fallers and non-fallers, and to distinguish the differences among them. It may benefit elderly fallers by improving their walking performance and reducing the risk of falling.

Reference:
[1] Chapman, G. J., & Hollands, M. A. (2006). Evidence for a link between changes to gaze behaviour and risk of falling in older adults during adaptive locomotion. *Gait & Posture, 24*, 288–294
[2] Young, W. R., & Hollands, M. A. (2012). Newly Acquired Fear of Falling Leads to Altered Eye Movement Patterns and Reduced Stepping Safety: A Case Study. *PLoS ONE, 7*(11), e49765

2-05

Effects of Multi-directional Visual Signals on Running Biomechanics

Anamaria Laudet Silva MANGUBAT, Ivan, Pui-hung AU, Roy, Tsz-hei CHEUNG
Gait & Motion Analysis Laboratory, Department of Rehabilitation Sciences, The Hong Kong Polytechnic University

Objectives:
The human body adjusts its temporal spatial parameters during running to minimize shock transmitted to the head and to maintain stability for navigation (Busa et al., 2016). It is currently unclear how the head and lower limbs absorb shock when visual signals from different directions are present. The purpose of this study, therefore, is to examine whether runners maintain stable head accelerations when responding to visual signals along the horizontal plane. We hypothesize that there will be no differences in the head accelerations of runners. We also hypothesize that runners may modify their tibial accelerations, stance time, stride frequency, and stride length to maintain constant head accelerations.

Methods:
Fifteen active runners (at least 10 km/week mileage, running more than 12 months) who are free from injury will be recruited from local running clubs. Two wireless accelerometers (MyoMotion, Noraxon, Arizona, USA) will be securely affixed onto the tibia and the head (Busa et al., 2016). Reflective markers will be placed according to Altman & Davis’ model (2012). Marker trajectories will be recorded with a motion capture system (Vicon, Oxford Metrics Group, Oxford, UK) and will be synchronized with the acceleration data.

A small electronics box containing 3 non-identical LED lights will be positioned two meters away from the center of the treadmill at 0, 45, 90, 135, and 180 degrees along the z-axis (Figure 1). Each subject will perform a standing calibration test to determine the height of the boxes. The subjects will wear a standard shoe model (Adizero Boost, Adidas, Herzogenaurach, Germany) and will run at their usual speed on the treadmill for four minutes (Cheung & Rainbow, 2014). After this adaptation period, each LED light will flash for thirty seconds in a random sequence. The subjects must identify the color and fix their gaze on that light until the next color is flashed.

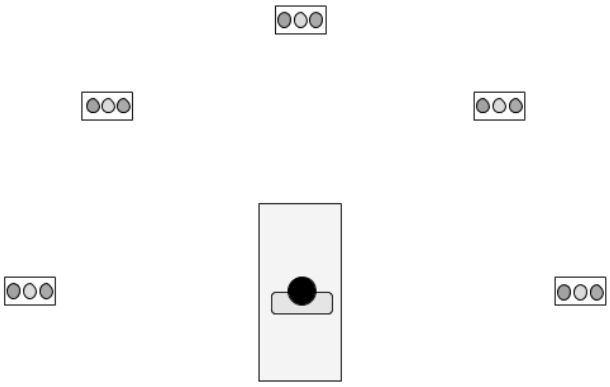


Figure 1. Experimental set-up: Top view

Data processing and statistics:
The head and tibial peak accelerations from each head position will be extracted for analysis. These are defined as the maximum positive acceleration in the early stance phase (Zhang et al., 2016). Stance time is defined as the time

difference between heel strike to toe-off, which will be derived from the kinematic data. Stride length will be calculated as treadmill speed (ms-1)/ stride frequency, where stride frequency is the number of strides per second.

A repeated measures design will be used, where the head and tibial accelerations, stance time, stride frequency, and stride length are the dependent variables, and the head positions are the independent variables.

Potential Implications:
The effect of head positions on head and tibial accelerations and temporal spatial parameters during running is currently unclear. Multi-directional visual signals may mimic real world scenarios, e.g. turning the head before crossing the road. These findings may provide more knowledge to enhance gait retraining protocols for running kinematics and kinetics control.

Reference:

[1] Altman, A.R., & Davis, I.S. (2012). A kinematic method for footstrike pattern detection in barefoot and shod runners. *Gait & Posture, 35*(2), 298-300.

[2] Busa, M.A, Lim, J., van Emmerik, R.E.A., & Hamill, J. (2016). Head and tibial accelerations as a function of stride frequency and visual feedback during running. *PLOS One* DOI:10.1371/journal.pone.0157297

[3] Cheung R.T.H., & Rainbow M.J. (2014). Landing pattern and vertical loading rates during first attempt of barefoot running in habitual shod runners. *Human Movement Sciences, 34,* 120–7.

[4] Zhang, J.H., An, W.W., Au, I.P.H., Chen, T.L., & Cheung, R.T.H. (2016). Comparison of the correlations between impact loading rates and peak accelerations measured at two different body sites: Intra- and inter-subject analysis. *Gait & Posture, 46*, 53-56.

 # 2-06

Correlation Between Tasks and Stability of Knee, and Performances within Multiple Types of Tasks

Tsz-ki NG[1], Kam-ming MOK[2]

[1] Deparment of Electronic Engineering, Faculty of Engineering, The Chinese University of Hong Kong

[2] Department of Orthopaedics and Traumatology, Faculty of Medicine, The Chinese University of Hong Kong

Objectives:
The condition of knee always affects how it performs very much. The better it is, the more difficult movement it can carry out. It is a very simple fact. When there are several assessment tasks, it is interesting to find out the extent of how well the knee can perform. Also, it is more important to know whether different persons will perform the best in different tasks. An experiment is going to be carried out for looking for the correlation.

Methods:
There are a number of methods to monitor the condition of knee. However, many of them are not perfect for clinical use. For example, biplanar fluoroscopy requires needle insertion during the measurement.1 The invasive nature is not suitable for daily clinical measurement. While laboratory-based optical motion capture system is highly demanding on the laboratory size and the intense environment. A portable motion capture system is used instead. It contains two infrared cameras attached to a portable workstation.

10 subjects are planned to be recruited for the experiment. Since the test focuses on the assessment tasks, the subjects should be without any previous history of injuries of the lower extremities. The participants will be required to perform three tasks with five trials for each of them. They are proposed to be Single-legged hop landing (SLHL), Single-legged squatting (SLS) and Double-legged squatting (DLS). We will acquire the tibiofemoral joint kinematics by observing the movements of them in six different degrees of freedom.

To realize the health condition of the subjects, they are given a set of questionnaire beforehand. The questions are mainly concerning how their knees have recovered if they had injured knees before. This process is important for us to get the basic information of the subjects.
In order to enhance the accuracy of the capturing process, calibration is required prior to the experiment. 6 markers will be stuck to the subjects and 13 points will be specified by an Opti-Knee operator afterwards.

After obtaining the data for each successful trial, the initial contact will be identified by calculation. The Side-to-side differences (SSDs) in the mean kinematic data will be calculated as well.2 This can help find out correlation of the knees on both sides of the participants.

At the end a ranking list will be produced, according to the range of motion of knee when performing the tasks.

Potential Implications:
We assume the knee will provide the same flexibility when the participant is performing different tasks. That means no matter which task is being taken place, the ranking of the rage of motion of the participants should be the same. This shows the correlation of the designed tasks. They will not affect the flexibility of the participants' knee.

Reference:
[1] JT Hing, AD Brooks, JP Desai. A biplanar fluoroscopic approach for the measurement, modeling, and simulation of needle and soft-tissue interaction. Medical Image Analysis. 2007;11(1);62-78.
[2] MY Yeung, SC Fu, KM Mok, SH Yung, KM Chan. Use of a portable motion analysis system for knee dynamic stability assessment in anterior cruciate ligament deficiency during single-legged hop landing. Asia-Pacific Journal of Sports Medicine, Arthroscopy, Rehabilitation and Technology. 2016;5;6-12.

 # 2-07

Biomechanical Difference in Forward Lunges and Lateral Lunges and Changes in Knee Joint Moment and Functional Measurement

Ming-chung POON[1], Kam-ming MOK[1]
[1] Department of Orthopaedics and Traumatology, The Chinese University of Hong Kong

Objectives:
Sport coaches generally prefer to have a pre-set training programme for improving athletes' condition and preventing injury. Lunge training is a popular training item and therapeutic exercise for athletes requiring lower limb movement because it requires eccentric contraction of quadriceps muscle, which shows improvement in patella tendinopathy and strengthening effect of quadriceps muscles [1]. Effectiveness of lunge training has been well established on various kinds of sports including badminton, fencing and squash [2, 3]. The variety of lunges results different knee biomechanics, since it has been reported that forward lunge and lateral lunge posed different stress on Patellofemoral Joint and Anterior Cruciate Ligament [4, 5, 6]. Nevertheless, few articles have investigated the difference of forward lunge and lateral lunge in correlation of functional performance. It was proposed that the difference in biomechanics during training will give a notable performance difference functionally. The research hypothesis were i)Forward and lateral lunge training will give different result in knee joint moment (in terms of VICON) and ii) There is a correlation between FMS score and knee joint moment

Methods:
Based on a sample size estimation from a previous study, minimum 15 subjects are required to attain sufficient statistical power [7]. The recruited subjects will be assessed in 3 motions, namely FMS in-line lunge, Forward Lunge (FL) and Lateral Lunge (LL).

To measure the different joint moment, subjects are asked to perform an adapted Functional Movement Screen (FMS) [9,10,11], which was proven reliable [12] and predictive in football injuries [13], with in-line lunge will be performed and scored in a 0-3 point scale. Measurement including a) adapted FMS score, b) video motion capture system, to capture and calculate the frontal angle and net knee joint moment [14,15,16] during FMS in-line squat, FL and LL will be taken in 3 trials each.

Potential Implications:
The comparison of frontal angle and knee joint moment calculated in video motion capture system may indicate the reflection of difference in knee joint moment in FMS in-line lunge, FL and LL, and its efficiency of reflection. Besides, the correlation of FMS score of in-line lunge and knee joint moment of FL and LL may indicate the possibility of prediction of knee joint moment or knee control performance using FMS.

Reference:
[1] Jönhagen S, Ackermann P, Saartok T. Forward Lunge: A Training Study of Eccentric Exercises of the Lower Limbs. Journal of Strength and Conditioning Research. 2009;23(3):972-978.
[2] CRONIN J, McNAIR P, MARSHALL R. Lunge performance and its determinants. Journal of Sports Sciences. 2003;21(1):49-57.
[3] Kuntze G, Mansfield N, Sellers W. A biomechanical analysis of common lunge tasks in badminton. Journal of Sports Sciences. 2010;28(2):183-191.
[4] Escamilla R, Zheng N, MacLeod T, Edwards W, Hreljac A, Fleisig G et al. Patellofemoral compressive force and stress during the forward and side

lunges with and without a stride. Clinical Biomechanics. 2008;23(8):1026-1037.
[5] Escamilla R, Zheng N, MacLeod T, Imamura R, Edwards W, Hreljac A et al. Cruciate ligament tensile forces during the forward and side lunge. Clinical Biomechanics. 2010;25(3):213-221.
[6] Begalle R, Distefano L, Blackburn T, Padua D. Quadriceps and hamstrings coactivation during common therapeutic exercises. J Athl Train. 2012;47(4):396-405.
[7] Riemann B, Congleton A, Ward R, Davies GJ. Biomechanical comparison of forward and lateral lunges at varying step lengths. J Sports Med Phys Fitness. 2013;53(2):130-8.
[8] McCurdy K, Walker J, Saxe J, Woods J. The Effect of Short-Term Resistance Training on Hip and Knee Kinematics During Vertical Drop Jumps. Journal of Strength and Conditioning Research. 2012;26(5):1257-1264.
[9] Cook G, Burton L, Hoogenboom B. Pre-participation screening: the use of fundamental movements as an assessment of function - part 1. N Am J Sports Phys Ther. 2006;1(2):62-72.
[10] Cook G, Burton L, Hoogenboom BJ, Voight M. Functional movement screening: the use of fundamental movements as an assessment of function - part 1. Int J Sports Phys Ther. 2014;9(3):396-409.
[11] Cook G, Burton L, Hoogenboom BJ, Voight M. Functional movement screening: the use of fundamental movements as an assessment of function-part 2. Int J Sports Phys Ther. 2014;9(4):549-63.
[12] Smith CA, Chimera NJ, Wright NJ, Warren M. Interrater and intrarater reliability of the functional movement screen. J Strength Cond Res. 2013;27(4):982-7.
[13] Kiesel K, Plisky PJ, Voight ML. Can Serious Injury in Professional Football be Predicted by a Preseason Functional Movement Screen? N Am J Sports Phys Ther. 2007;2(3):147-58.
[14] Weeks B, Carty C, Horan S. Kinematic predictors of single-leg squat performance: a comparison of experienced physiotherapists and student physiotherapists. BMC Musculoskeletal Disorders. 2012;13(1).
[15] Ugalde V, Brockman C, Bailowitz Z, Pollard C. Single Leg Squat Test and Its Relationship to Dynamic Knee Valgus and Injury Risk Screening. PM&R. 2015;7(3):229-235.
[16] Mok K, Petushek E, Krosshaug T. Reliability of knee biomechanics during a vertical drop jump in elite female athletes. Gait & Posture. 2016;46:173-178.
[17] Maurer T, Pierce H. A comparison of Likert scale and traditional measures of self-efficacy. Journal of Applied Psychology. 1998;83(2):324-329.

 # 2-08

Compare the Validity of Movement Tasks for Analysis of Function of Anterior Cruciate Ligament Using Portable System

Long-ho WONG[1], Kam-ming MOK[2]
[1] Department of Electronic Engineering, The Chinese University of Hong Kong
[2] Department of Orthopaedics and Traumatology, The Chinese University of Hong Kong

Objectives:
In order to evaluate the function of Anterior Cruciate Ligament (ACL), dynamic stability acts as critical indicator. The aim of the study is to design and test the validity of movement tasks for the analysis of the function of ACL by comparing the kinematic data of left and right leg from five trials of each task using marker-based motion analysis system.

Methods:
10 individuals (age range: 18-30 years) are recruited in this study and they at least involve in workout regularly with not less than 1 hour per week. Subject knee evaluation form with Lysholm Knee Scoring is filled by subject to collect the medical history and demographic data.1 Subject is supposed to carry out three specific motions: Single-Legged Hop, Single-Legged Squat, and Double-Legged Squat. At least three successful trials and both left and right legs assessment are required for each motion. Kinematic data of both legs obtained respectively from three specific motions will be compared, thus contributing to find out which movement task is more suitable for evaluation.

Potential Implications:
Different motion tasks affect the kinematic data obtained in the study and a good motion task is supposed to objectively reflect the function of ACL2. In other words, the motion task is consistent, stable and reliable whenever. Therefore, motion task with high dynamic stability in terms of kinematic data is well-suited.

Reference:
[1] MY Yeung, SC Fu, KM Mok, SH Yung, KM Chan. Use of a portable motion analysis system for knee dynamic stability assessment in anterior cruciate ligament deficiency during single-legged hop landing. AP J Sports Med. 2016;5:6-12.
[2] Chua EN, Yeung MY, Fu SC, et al. Motion task selection for kinematic evaluation after anterior cruciate ligament reconstruction: a systematic review. Arthroscopy J Arthrosc Relat Surg. 2016;32:1453-1465.

2-09

The Association of Physical Activity and Physical Literacy of School Principals among Cross-Strait Four Regions

Po-ling WONG, Raymond Kim-wai SUM
Department of Sports Science and Physical Education, The Chinese University of Hong Kong

Objectives:
This study aims to investigate the physical activity (PA) level and self-perception of physical literacy (PL) among school principals in cross-strait four regions (Mainland China, Hong Kong, Taiwan and Macau); and use Sports Law or sport policy to study the impact and differences on both development of principal's PA and PL, and schools' sports.

Methods:
A total of 120 school principals will be randomly selected to participate in the study from Mainland China, Hong Kong, Taiwan and Macau. The methods of collecting data will be an online survey, which will be designed using SoGoSurvey. The Web survey will email to all primary and secondary schools' principals in the four regions (Zhuhai and Zhongshan in Guangdong Province: 474 1, HK: 10782, Taiwan Taipei: 2243, Macau: 774) as the response rate of this method is 15.1%5. The purposes of this study are to identify the level of PA and self-perception of PL among principals; and to explore the impacts of Sports Law in different regions. The International Physical Activity Questionnaire6 (IPAQ) and Perceived Physical Literacy Instrument7 (PPLI) will be used to examine PA and PL; demographic information will also be involved as to gain a general understand about the principals and school sports. The web survey will comprise 36 questions organized into two sections of PA and PL; the third section will be the demographic information. Likert-scale will be applied in the PL survey indicating participants' agreement on a 5-point scale and IPAQ scoring protocol will be used to classify the PA level of the subjects. Data collection period will be conducted from December 2016 to January 2017 that according to the Web survey responses.

Potential Implications:
The results of the study will demonstrate the physical activity level and perceived physical literacy of the school principals from 4 regions who are the decision and policy makers, and educational reformers who have administrative-managerial authority to dominating the development of schools8. In addition, the PA and PL of school principals will also indicate the success of the Sports Law and sport policy and the effectiveness of sports development. To highlight the significant of Sports Law and responsibilities of the school principals and other educators, the following recommendations are therefore proposed for the government. It is crucial to promote Sports Law or policies for every school and enhance related knowledge to educators and senior management. Programs, talks or conferences that emphasis the content of the Laws related to school sports should be implemented. Furthermore, the Sports Laws or sport policy from each region are suggested to modify the insufficient areas that have been affected the PA opportunities. For further study, it should focus on students because the school sports policies directly affect their PA participation and perceived PL. It is desirable to study Sports Law and school sports, as educators, government, parents and sports organizations are crucial to realizing the circumstance.

Reference:
[1] 51SXUE. (2016). 廣東省學校列表. Retrieved from http://xuexiao.51sxue.com/slist/?o=&t=2&areaCodeS=44&level=&sp=&score=&order=&areaS=%B9%E3%B6%AB%CA%A1&searchKey=&page=270
[2] Education Bureau, The Government of the Hong Kong Special Administrative Region. (2016). *Key Statistics on Kindergarten, Primary, Secondary and Special Education.*Retrieved from http://www.edb.gov.hk/tc/about-edb/publications-stat/figures/pri.html
[3] Department of Education,Taipei City Government. (2016). *Primary education, Junior high school education, Senior high school education.* Retrieved from http://www.doe.gov.taipei/np.asp?ctNode=33499&mp=104001
[4] Education and Youth Affairs Bureau, Government of the Macao Special Administrative Region. (2016). *Educational Statistic: table of school statistical data (Scholastic year 2015/2016).* Retrieved fromhttp://portal.dsej.gov.mo/webdsejspace/internet/category/teachorg/Inter_main_page.jsp?id=8492
[5] Cale, L., Harris, J., & Duncombe, R. (2016). Promoting physical activity in secondary schools Growing expectations, 'same old' issues?. *European Physical Education Review*, 1356336X15623774.
[6] Booth, M. L. (2000). Assessment of physical activity: an international perspective. Research USA Spanish version translated 3/2003-Long Last 7 Days Self-Administered version of the IPAQ. Revised October 2002 [en línea]. *Quarterly for Exercise and Sport, 71* (2): s114-20.
[7] Sum, R. K. W., Ha, A. S. C., Cheng, C. F., Chung, P. K., Yiu, K. T. C., Kuo, C. C., ... & Wang, F. J. (2016).Construction and Validation of a Perceived Physical Literacy Instrument for Physical Education Teachers. *PloS one*, *11*(5), e0155610.
[8] Oplatka*, I. (2004). The principalship in developing countries: Context, characteristics and reality. *Comparative Education*, *40*(3), 427-448. doi:10.1080/0305006042000274872

2-10

The Acute Effect of Self-Myofascial Release, Dynamic Stretching and Combination of Self-Myofascial Release and Dynamic Stretching on Lower Limb Muscle Flexibility and Performance

Ying-ying CHAN[1], Justin LEE[1], Patrick YUNG[1]
[1]Department of Orthopaedics and Traumatology, The Chinese University of Hong Kong

Background:
Dynamic stretching was found to be effective in improving lower limb muscle flexibility and muscle performances. (Amiri-Khorasani & Sotoodeh, 2013; Ryan et al., 2014) Self-myofascial release eg. Foam roller, was commonly used in warm-up recently and was believed to be effective in improving lower limb muscle flexibility while not affecting the performance.(Junker & Stöggl, 2015; Peacock, Krein, Silver, Sanders, & Von Carlowitz, 2014; Sung-Hak & Soo-Han, 2016). However, limited studies with small subject number had been performed on its effect. Analysing effect of dynamic stretching, self-myofascial release and dynamic stretching together with self-myofascial release on lower flexibility and performance would guide development of warm-up program.

Research Gap:
Limited researches had been conducted for investigating the acute effect of SMR. No current studies compared the effect of dynamic stretching, self-myofascial release and dynamic stretching together with self-myofascial release on lower limb muscle flexibility and performance.

Objectives:
1. To study the acute effect of self-myofascial release on lower limb muscle flexibility and performance
2. To compare the acute effect of self-myofascial release on lower limb muscle flexibility and performance with dynamic stretching
3. To study whether self-myofascial release together with dynamic stretching has added benefit to lower limb muscle flexibility and performance

Methods:
16 to 20 physically active subjects with no recent lower limb injury in past three months would be recruited and randomized into four groups and be asked to perform the interventions in four non-consecutive days.

Muscle flexibility (eg. sit and reach test) and performance (eg. lower limb strength, vertical jump, flying 20m sprinting) would be measured before and two minutes after the interventions.

Intervention
R: Relaxation
DS: Dynamic stretching
SMR: Self-myofascial release
SMR+DS: Self-myofascial release + Dynamic stretching
*Same muscle groups would be used under different experimental group
**BLACKROLL would be used for SMR intervention

Testing Schedule

	First Day	Second Day	Third Day	Forth Day
Group 1	R	SMR+DS	SMR	DS
Group 2	DS	R	SMR+DS	SMR
Group 3	SMR	DS	R	SMR+DS
Group 4	SMR+DS	SMR	DS	R

After the data collection, A 2(before intervention & after intervention) X 4(relaxation, dynamic stretching, self-myofascial release, Self-myofascial release+ dynamic stretching) Repeated Measures ANOVA would be used for statistical analysis in SPSS 22.0. A significance level of alpha =0.05 will be considered as statistically significant for the analysis. One-way ANOVA would be performed to confirm significant difference between different interventions. Paired sample t-test would be performed to confirm significant within interventions effect.

Potential Implications:
Self-myofascial release could be included in warm up program and even replace dynamic stretching to enhance lower limb flexibility and muscle performance. In addition, self-myofascial release together with dynamic stretching may further enhance lower muscle flexibility and muscle performance compared with dynamic stretching or self-myofascial release alone.

Reference:
[1] Amiri-Khorasani, M., & Sotoodeh, V. (2013). The acute effects of combined static and dynamic stretch protocols on fitness performances in soccer players. *Journal of Sports Medicine and Physical Fitness, 53*(5), 559.
[2] Junker, H. D., & Stöggl, L. T. (2015). The Foam Roll as a Tool to Improve Hamstring Flexibility. *Journal of Strength and Conditioning Research, 29*(12), 3480-3485. doi: 10.1519/jsc.0000000000001007
[3] Peacock, C. A., Krein, D. D., Silver, T. A., Sanders, G. J., & Von Carlowitz, K.-P. A. (2014). An Acute Bout of Self-Myofascial Release in the Form of Foam Rolling Improves Performance Testing. *International Journal of Exercise Science, 7*(3), 202-211.
[4] Ryan, E. D., Everett, K. L., Smith, D. B., Pollner, C., Thompson, B. J., Sobolewski, E. J., & Fiddler, R. E. (2014). Acute effects of different volumes of dynamic stretching on vertical jump performance, flexibility and muscular endurance. *Clinical Physiology and Functional Imaging, 34*(6), 485-492. doi: 10.1111/cpf.12122
[5] Sung-Hak, C., & Soo-Han, K. (2016). Immediate effect of stretching and ultrasound on hamstring flexibility and proprioception. *Journal of Physical Therapy Science, 28*(6), 1806-1808.

2-11

The Use of Thermosensitive mPEG-polyalanine Hydrogel to Localize Platelet-Rich Plasma for Intra-tendinous Injection

Yuan-dong JIANG, Sai-chuen FU, Yau-chuk CHEUK, Patrick Shu-Hang YUNG
Department of Orthopaedics and Traumatology, The Chinese University of Hong Kong

Platelet-rich plasma (PRP) is defined as the volume of autologous plasma with greater platelet level than baseline. As a new biological therapy, PRP is supposed to stimulate self-healing process through the release of many kinds of bioactive substances in platelets. It has been ubiquitously used in orthopedics field, including tendinopathy treatment, osteoarthritis treatment, ACL reconstruction, bone integration, and rotator cuff repair. But its effectiveness remained controversial due to no clear consensus regarding the volume of PRP,3 composition of PRP or number of injection according to previous studies. One thing may be overlooked is the localization of PRP ----whether or not PRP has been retained exactly at the site of injury and taken sustainable effect. As a minimally invasive treatment, injection is the most common way to deliver PRP for tendinopathy. However, in many cases PRP was used in liquid formulation that means PRP would flow away from tendons right after injection. Unlike the joint space for intra-articular injections, the space around tendon is limited, thereby restricting the PRP injection volume. Moreover, in order to deliver larger amount of PRP to a wider area, peppering technique (multipoint injections) was used to inject PRP that might cause extra micro-trauma and possibly more leakage of PRP. To help PRP to play its role effectively, the thermosensitive mPEG-polyalanine hydrogel may be a localization-enhancing vehicle for PRP. The thermosensitive hydrogel is an injectable liquid at low temperature and is able to transform to a semisolid hydrogel at body temperature, which means soon after injection, mixture of PRP and hydrogel may localize at the target tissue at body temperature.

Objectives:
The aim of this research is to determine whether thermosensitive hydrogel helps to immobilize PRP at the site of injection and prolong the retention of PRP. The comparison between PRP with thermosensitive hydrogel and PRP only after intra-tendinous injection will be made by assessment of the gel and platelet retention at different time points post injection.

Methods:
Animal: 15 male Sprague-Dawley rats (at least 8 weeks).

Interventions:
Firstly, PRP withdraw from other rats will be prepared by double centrifugation method. The platelet in it will be labeled with Superparamagnetic iron oxide nanoparticles (SPIONs). And the thermosensitive mPEG-polyalanine hydrogel is already fluorescein isothiocyanate (FITC)-labeled. In the second portion of the study, PRP will be injected into the left patellar tendons of 15 rats, while the mixture of PRP and mPEG-polyalanine hydrogel (FITC-labeled) injected into the right. Ultrasound images will be taken after the injection to ensure the location of PRP or PRP-gel injected. Lastly, at 1hour, 7day, 14day post injection, patellar tendons of the rats (n=5) will be harvested for histological examination. *In-vivo* image system and fluorescent microscopy will be used to examine the retained volume of SPIONs-labeled platelets and FITC-labeled hydrogel.

Main outcome measures: 1) SPIONs-labeled platelets retention; 2) FITC-labeled hydrogel retention.

Potential Implications:
PRP may heal tendinopathy in clinic, but it is difficult to retain PRP around tendon. If thermosensitive mPEG-polyalanine hydrogel can be an effective vehicle to retain PRP at the site of injection, the longer retention of PRP may contribute to better PRP therapeutic effect. This research could be a basement for defining optimal PRP treatment protocol being applied to tendinopathy and other musculoskeletal diseases.

Reference:
[1] Hall M P, Band P A, Meislin R J, et al. Platelet rich Plasma: Current Concepts and Application in Sports Medicine[J]. Journal of the American Academy of Orthopaedic Surgeons, 2009, 17(10): 602-608.
[2] Foster TE, Puskas BL, Mandelbaum BR, Gerhardt MB, Rodeo SA. Platelet-rich plasma: from basic science to clinical applications. Am J Sports Med. 2009;37(11):2259–72.
[3] Tsikopoulos K, T.I., Simeonidis E, Papathanasiou E, Haidich AB, Anastasopoulos N, Natsis K., The clinical impact of platelet-rich plasma on tendinopathy compared to placebo or dry needling injections: A meta-analysis. Phys Ther Sport., 2016. 17: p. 87-94.
[4] Khoshbin A, L.T., Wasserstein D, Marks P, Theodoropoulos J, Ogilvie-Harris D, Gandhi R, Takhar K, Lum G, Chahal J., The efficacy of platelet-rich plasma in the treatment of symptomatic knee osteoarthritis: a systematic review with quantitative synthesis. Arthroscopy., 2013. 29(12): p. 2037-48.
[5] Andriolo L, D.M.B., Kon E, Filardo G, Venieri G, Marcacci M., PRP Augmentation for ACL Reconstruction. BioMed Research International, 2015.
[6] Roffi A, F.G., Kon E, Marcacci M., Does PRP enhance bone integration with grafts, graft substitutes, or implants? A systematic review. BMC Musculoskelet Disord., 2013. 14: p. 330.
[7] Chahal J, V.T.G., Mall N, Heard W, Bach BR, Cole BJ, Nicholson GP, Verma NN, Whelan DB, Romeo AA., The role of platelet-rich plasma in arthroscopic rotator cuff repair: a systematic review with quantitative synthesis. Arthroscopy., 2012. 28(11): p. 1718-27.
[8] Fitzpatrick J, Bulsara M, Zheng M H. Effectiveness of Platelet-Rich Plasma in the Treatment of Tendinopathy: Response[J]. The American Journal of Sports Medicine, 2016, 44(10): NP55-NP56.
[9] Andia I, Latorre P M, Gomez M C, et al. Platelet-rich plasma in the conservative treatment of painful tendinopathy: a systematic review and meta-analysis of controlled studies[J]. Br Med Bull, 2014, 110(1): 99-115.
[10] Nguyen R T, Borg-Stein J, McInnis K. Applications of platelet-rich plasma in musculoskeletal and sports medicine: an evidence-based approach[J]. PM&R, 2011, 3(3): 226-250.
[11] Wiegerinck J I, Reilingh M L, de Jonge M C, et al. Injection Techniques of Platelet-Rich Plasma Into and Around the Achilles Tendon A Cadaveric Study[J]. The American journal of sports medicine, 2011, 39(8): 1681-1686.

2-12

Sports Injury of University Athletes in Hong Kong

Wai-ling LEUNG, Kam-ming MOK
Department of Orthopaedics & Traumatology, Faculty of Medicine, The Chinese University of Hong Kong

Objectives:
Sports injuries are inevitable for the athletes. Medical support services are required to stabilize the injured site, relieve the symptoms, prevent further injury and promote healing. For example, the Hong Kong Sports Institute has a Sports Medicine Centre for the scholarship athletes. In addition, physicians provide medical consultations to professional football teams in Hong Kong Premier League. However, compared to the professional elite athletes, the university athletes have limited medical support. In order to develop a specific medical service for university athletes, an understanding of their sports habit and sports injury is needed. Hence, a study of their injury pattern needs to be done to understand the epidemiology of sports injury in university athletes.

Previous studies on epidemiology of one specific type of injury exists, such as concussion (Zuckerman et al. 2015) and hamstring strain injury (Opar et al. 2014). Comparing injury pattern between countries is also available (Ristolainen et al. 2010). In Hong Kong, similar studies have only been done on sports injury incidence of young athletes (Daswani et al. 2015) and elite badminton athletes (Yung et al. 2007). For the university level in Hong Kong, a survey was done back in the 80s to investigate the injury pattern of students, which included year 1 students who attended the physical fitness assessment programme and year 2 students who selected physical education elective course (Chan et al. 1984). While there is no recent survey on the epidemiology of sports injury in Hong Kong university athletes, our study will be solely focused on the injury pattern of university athletes who play for the university teams. The objectives of the current study are 1) to study injury pattern, including involved body part, mechanism, types of injury, and 2) to provide descriptive analysis of injury pattern and odd ratios of injury occurrence between different sports.

Methods:
Questionnaire will be used to investigate the injury experience in the past one year of the university athletes in the Chinese University of Hong Kong (CUHK) sports team. The items in the questionnaire will include defining whether it is an acute or overuse injury, the nature of the injury (muscle sprain, tendonitis, fracture etc.), the anatomical location of the injury, injury mechanism, treatment received, the time loss before returning to training or competition, etc. Another form for assessing their sports injury prevention adherence will also be attached to investigate their effort on preventing sports injury. The questionnaires will be distributed to sports team members who represent CUHK. CUHK sports research clinic attendee, who have musculoskeletal problem resulting from sports injury, will also be surveyed. Descriptive statistics will be used for data analysis part. Odd ratios for predicting odds of injury will be calculated.

Potential Implications:
The descriptive analysis of the study can be used to understand the pattern of injury in different kinds of sports and the possible causes of sports injury. The most common sports injury for certain kind of sports can be listed to develop specific injury prevention programme for those particular sports. Medical resources can be allocated to treat sports injury which has a high occurrence according to the statistical result.

Reference:
[1] Chan, K. M., Fu, F., & Leung, L. (1984). Sports injuries survey on university students in Hong Kong. *British journal of sports medicine*, *18*(3), 195-202.
[2] Daswani, D. D., Lee, W. Y. J., & Yung, S. H. P. (2015). Survey on team sports-related injury and management in young Hong Kong athletes. *Hong Kong Physiotherapy Journal*, *2*(33), 102.
[3] Opar, D. A., Drezner, J., Shield, A., Williams, M., Webner, D., Sennett, B., ... & Cronholm, P. F. (2014). Acute hamstring strain injury in track-and-field athletes: A 3-year observational study at the Penn Relay Carnival. *Scandinavian journal of medicine & science in sports*, *24*(4), e254-e259.
[4] Ristolainen, L., Heinonen, A., Turunen, H., Mannström, H., Waller, B., Kettunen, J. A., & Kujala,
[5] U. M. (2010). Type of sport is related to injury profile: A study on cross country skiers, swimmers, long-distance runners and soccer players. A retrospective 12-month study. *Scandinavian journal of medicine & science in sports*, *20*(3), 384-393.
[6] Yung, P. S. H., Chan, R. H. K., Wong, F. C. Y., Cheuk, P. W. L., & Fong, D. T. P. (2007). Epidemiology of injuries in Hong Kong elite badminton athletes.*Research in sports medicine*, *15*(2), 133-146.
[7] Zuckerman, S. L., Kerr, Z. Y., Yengo-Kahn, A., Wasserman, E., Covassin, T., & Solomon, G. S. (2015). Epidemiology of sports-related concussion in NCAA athletes from 2009-2010 to 2013-2014 incidence, recurrence, and mechanisms.*The American journal of sports medicine*, *43*(11), 2654-2662.

2-13

Development of an Anti-Ankle Sprain Shoe that Prevents Ankle Inversion through Myoelectric Stimulation

Sze-man WONG[1], Tsz-lok LAM[1], Sui-Sang WONG[2], Kam-ming MOK[3], Darwin Tat-ming LAU[2]

[1] Biomedical Engineering Programme, Department of Electronic Engineering, Faculty of Engineering, The Chinese University of Hong Kong

[2] Department of Mechanical and Automation Engineering, Faculty of Engineering,The Chinese University of Hong Kong

[3] Department of Orthopaedics and Traumatology, Prince of Wales Hospital, Faculty of Medicine, The Chinese University of Hong Kong

Background:

Ankle sprains are a common sports injury.[3] The tearing of ankle ligaments is mainly due to the excessive stress during excessive supination motion, which is a combination of inversion and plantar flexion.[2] Currently, different prophylactic approaches such as taping and bracing are adopted, but they would restrict the freedom of ankle joint motion, adversely affecting the performance of athletes.[5] Myoelectric stimulation is highly considered as an alternative with its potential effectiveness.[4] This study aims to develop a shoe featured with ankle sprain detection and prevention by myoelectric stimulation for excessive inversion and plantar flexion-induced ankle sprain.

Objectives:

Ankle sprain detection

Compare different kinds of sensors including gyrometers, bend sensors and pressure sensors to find out the most accurate and effective combination of sensors for detecting ankle sprain.

Optimization of myoelectric stimulation

Optimize the effectiveness of myoelectric stimulation and minimize the adverse effects such as physical pains brought to the users by attempting different combinations of stimulated muscle contraction, positions and voltage.

Fabrication of ankle sprain models

Fabricate models that mimic ankle sprain under different kinematics for testing the anti-ankle sprain shoe in terms of accuracy and sensitivity of the sensors. This provides a more ethical and practical test method when compared to performing tests on human.

Methods:

Ankle sprain detection

The detection and prediction of ankle sprain would be performed by sensors including bend sensors and pressure sensors. Ankle sprain models would be used to test the accuracy of sensors. Afterwards, human subjects would be requested to perform different motions including walking, running, vertical jump-landing, sliding step and stepping-down to avoid false positive results.

Optimization of myoelectric stimulation

A muscle stimulator fabricated by the university electronics services unit with adjustable voltage magnitude [4] would be adopted to induce muscle contraction in different combinations. In the previous studies, peroneal muscles were found to be successfully resist ankle sprain.[4] However, owing to its small size, the effect was not obvious. Thus, the muscle stimulator would be applied to investigate alternative muscles for resisting ankle sprain more effectively. To find out the optimum stimulation voltage, the ankle sprain models, which could help to find out the torque needed to resist ankle sprain, would be used. With the data of the maximum torque of normal pronation found in the previous studies, [2] we could further calculate the lower and upper limits for the voltage needed. Further testing on human subjects performing volunteer pronation [2] is required to verify the effectiveness.

Fabrication of ankle sprain models

Ankle sprain models would be fabricated to mimic different types of ankle sprains. A simple foot model would be designed with SolidWorks and printed out by a 3D printer. To enable its sprain motion, a stepper motor would be applied onto the ankle part of the foot model. The angle, position, and speed of the motors could be deduced by the torque and speed of ankle sprains from analyzing the previous ankle sprain studies. By applying the motor to different positions, inversion, plantar-flexion and internal rotation ankle sprain can be mimicked.

Potential Implications:

As mentioned above, mechanical prevention restricts the freedom of motion of the users. On the other hand, a shoe equipped with myoelectric stimulation enables immediate correction of the movement before ankle sprain occurs without movement restriction. As the ankle spraining motion is continuous and in high velocity, detection by pressure sensors enables active trigger of muscle contraction before the body responds. The realization of an anti-ankle sprain shoes would be a blessing to athletes and other potential users such as the elderly.

Reference:

[1] D. T.-P. Fong, D. Wang, V. W.-S. Chu, and K.-M. Chan, “Myoelectric stimulation on peroneal muscles with electrodes of the muscle belly size attached to the upper shank gives the best effect in resisting simulated ankle sprain motion,” *Journal of Biomechanics*, vol. 46, no. 6, pp. 1088–1091, Apr. 2013.

[2] D. T.-P. Fong, M. M.-L. Chung, Y.-Y. Chan, and K.-M. Chan, “A mechanical jig for measuring ankle supination and pronation torque in vitro and *in vivo*,” *Medical Engineering & Physics*, vol. 34, no. 6, pp. 791–794, Jul. 2012.

[3] D. T.-P. Fong, S. C.-W. Ha, K. -M. Mok, C. W. -L. Chan and K. -M. Chan, “Kinematics analysis of ankle inversion Ligamentous Sprain injuries in sports: Five cases from televised tennis competitions,” *The American Journal of Sports Medicine*, vol. 40, no. 11, pp. 2627–2632, Sep. 2012.

[4] D. T.-P. Fong, V. W.-S. Chu, and K.-M. Chan, “Myoelectric stimulation on peroneal muscles resists simulated ankle sprain motion,” *Journal of Biomechanics*, vol. 45, no. 11, pp. 2055–2057, Jul. 2012.

[5] Y.-Y. Chan et al., “Identification of ankle sprain motion from common sporting activities by dorsal foot kinematics data,” *Journal of Biomechanics*, vol. 43, no. 10, pp. 1965–1969, Jul. 2010.

2-14

An Investigation of the Effect of Platelet-rich Fibrin (PRF) to Treat Anterior Cruciate Ligament (ACL) Partial Tear in a Rat Model

Shao-qi ZHANG[1], Yue LI[1], Bruma SC FU[1], Angel YW LEE[1], Patrick SH YUNG[1]

[1]Department of Orthopaedics and Traumatology, The Chinese University of Hong Kong

Background:

Anterior cruciate ligament (ACL) injury is common trauma during sport activity and accounts for nearly half of the knee ligament injuries [1]. Partial tears of the anterior cruciate ligament are frequent and represent 10 to 27% of the total ACL injuries [3]. The clinical presentation of ACL partial tear is characterized by pain, partial functional limitation, hemarthrosis and the possibility of episodes of instability [4]. The ACL partial tear is diagnosed by pivot shift test, Lachman test, MRI findings, and diagnostic arthroscopy. Currently, ACL partial tear is treated by either conservative treatment or ACL Reconstruction surgery. As healing capacity of ACL is very low [11-13], knee instability may still be present in patients receiving conservative treatments and expose the patients to a high risk of the development of posttraumatic degenerative joint disease [1]. Few patients returned to the pre-injury activity level by conservative treatments, and the incidence of progression to complete tear is 11%-62% [16]. On the contrary, ACL reconstruction can help to restore knee stability but the surgical trauma and slow graft incorporation may take too much time for rehabilitation [3], and the rates of recurrent laxity 1 year postoperatively have been reported to be as high as 17% [15]. It would be better to devise a new treatment to promote healing in ACL partial tear. Recently, new strategies using growth factors such as Platelet-rich Plasma (PRP) to treat ACL injuries show positive effects [2,14], but it is difficult to localize PRP around ACL. As PRP is liquid before activation, it may be lost from the vicinity of the graft after application. Platelet-rich fibrin (PRF) is a blood-derived fibrin network containing clusters of activated platelets and leukocytes [5]. Currently, PRF is used in regenerative oral surgery procedures [9,10] but there is no article which suggests that PRF has treatment effect on ACL injuries. So its treatment effect on ACL partial tear has not been investigated.

Objectives:

To investigate the effect of PRF on ACL partial tear healing in a rat model.

Methods:

Two Male Sprague –Dawley rats (14 weeks old) will be anaesthetized by isoflurane, we use orbital sinus sampling to get 3ml blood in a glass tube. Centrifuge it immediately (400g, 10min, 22℃). The PRF is a yellowish gel in the middle of the tube. Remove the clot (about 1ml) from the tube and place it on gauze for next step. 16 Male Sprague –Dawley rats (12 weeks old) will be used After general anesthesia, a 1.5 cm incision is made on skin to expose patellar tendon. Patellar tendon will be dislocated and fat pad will be excised to expose ACL. Syringe needle (30G) will used to create a standardized lesion on the femoral insertion site of ACL (<50% of the width of ACL) under adjustable magnifier. The rats will then receive either 0.2ml PRF or saline. The joint capsule and skin will be closed by suture. At 1 or 2 weeks post injury (n=4), the rats will be euthanized with intraperitoneal injection of overdose pentobarbital. The whole knee including the patellar tendon will be harvested, fixed in buffered formalin, decalcified, embedded and sectioned for histological examination. The sections will be stained with hematoxylin and eosin, the extent of fibrillogenesis and the cellularity in the lesion site will be evaluated.

Potential Implications:

If PRF can promote self-healing of partially torn ACL, it will lead to a novel treatment which may be a better choice as compared to conservative treatment and reconstructive surgery.

Reference:

[1] DeFranco MJ, Bach Jr BR. A comprehensive review of partial anterior cruciate ligament tears. J Bone Joint Surg Am 2009;91:198-208.
[2] Martha M. Murray, Kurt P. Spindler, Eduardo Abreu, John A. Muller, Arthur Nedder, Mark Kelly, John Frino, David Zurakowski, Maria Valenza, Brian D. Snyder, Susan A. Connolly. Collagen-platelet rich plasma hydrogel enhances primary repair of the porcine anterior cruciate ligament. Journal of Orthopaedic Research. 2007;25(1):81-91
[3] P. Colombet, D. Dejour, J.-C. Panisset, R. Siebold, The French Arthroscopy Society. Current concept of partial anterior ligament ruptures. Orthopaedics & Traumatology: Surgery & Research 2010;96S:S109-S118.
[4] Eduardo Frois Temponi, Lucio Honorio de Carvalho Junior, Bertrand Sonnery-Cottet, Pierre Chambat. Partial tearting of the anterior cruciate ligament: diagnosis and treatment. REV BRAS ORTOP 2015;50(1):9-15.
[5] Dohan Ehrenfest DM, Choukroun J, Diss A, Dohan SL, Dohan AJJ, Mouhyi J, et al. Platelet-rich fibrin (PRF): A secondgeneration platelet concentrate. Part I: Technological concepts and evolution. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2006;101:37-44.
[6] Dohan Ehrenfest DM, Choukroun J, Diss A, Dohan AJJ, Mouhyi J, Gogly B. Plateletrich fibrin (PRF): A second-generation platelet concentrate. Part II: Plateletrelated biologic features. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2006;101:45-50.
[7] Dohan Ehrenfest DM, Peppo de GM, Doglioli P, Sammartino G. Slow release of growth factors and thrombospondin-1 in Choukroun's platelet-rich fibrin (PRF): A gold standard to achieve for all surgical platelet concentrates technologies. Growth Factors. 2009;27:63-9.
[8] Su CY, Kuo YP, Tseng YH, CH Su, Burnouf T. In vitro release of growth factors from platelet-rich fibrin (PRF): A proposal to optimize the clinical applications of PRF. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2009;108:56-61.
[9] Sharma AA, Pradeep AR. Autologous platelet rich fibrin in the treatment of mandibular Degree II furcation defects: A randomized clinical trial. J Periodontal. 2011;82:1396-403.
[10] Sharma AA, Pradeep AR. Treatment of 3wall intrabony defects in chronic periodontitis subjects with autologous platelet rich fibrin: A randomzed controlled clinical trial. J Periodontol. 2011;82:170512.
[11] Arnoczky SP, Rubin RM, Marshall JL. Microvasculature of the cruciate ligaments and its response to injury. An experimental study in dogs. J Bone Joint Surg Am. 1979;61:1221-9.
[12] Maekawa K, Furukawa H, Kanazawa Y, Hijioka A, Suzuki K, Fujimoto S. Electron and immunoelectron microscopy on healing process of the rat anterior cruciate ligament after partial transection: the roles of multipotent fibroblasts in the synovial tissue. Histol Histopathol. 1996;11:607-19.
[13] O'Donoghue DH, Rockwood CA Jr, Frank GR, Jack SC, Kenyon R. Repair of the anterior cruciate ligament in dogs. J Bone Joint Surg Am. 1966;48:503-19.
[14] Kenichi Oe, Taketoshi Kushida, Naofumi Okamoto, Masayuki Umeda, Tomohisa Nakamura, Susumu Ikehara, Hirokazu IidaNew. Strategies for Anterior Cruciate Ligament Partial Rupture Using Bone Marrow Transplantation in Rats. STEM CELLS AND DEVELOPMENT. Volume 20, Number 4, 2011.
[15] Tyler TF, McHugh MP, Gleim GW, Nicholas SJ. Association of KT-1000 measurements with clinical tests of knee stability 1 year following anterior cruciate ligament reconstruction. J Orthop Sports Phys Ther 29:540-542, 1999.
[16] Sandberg R, Balkfors B. Partial rupture of the anterior cruciate ligament. Natural course. Clin Orthop Relat Res. 1987;220:176-8.

2-15

Design for the EMG-Driven Cable-Robot Exoskeleton for Shoulder Rehabilitation Devices

Hung-hon CHENG[1], Hang-man YIP[2], Darwin Tat-ming LAU[3], Kai-yu TONG[4]
[1] Department of Mechanical and Automation Engineering Department, The Chinese University of Hong Kong
[2] Division of Biomedical Engineering, Department of Electronic Engineering, The Chinese University of Hong Kong
[3] Department of Mechanical and Automation Engineering Department, The Chinese University of Hong Kong
[4] Division of Biomedical Engineering, Department of Electronic Engineering, The Chinese University of Hong Kong

Project Objectives:
This project consists of mechanical and biomedical components. This proposal mainly includes the mechanical design of the project.

The project aims to develop a cable-driven robot for human shoulder rehabilitation. The design of exoskeleton will match the cables to the patient's anatomy for specific muscle training. Electromyography (EMG) will be studied from the healthy subjects and used to drive the Myomuscle cable-actuator units for shoulder muscle training. This approach aims to bring a new methodology for shoulder neuromuscular rehabilitation.

Compared with the main features of the existed rehabilitation robots, this device will provide assistance to the specific individual muscles with variable desired force for patients to complete the tasks by themselves instead of only providing gross motion. The devices will provide variable force to train the related muscles to complete tasks. This idea is called assist-as-needed (AAN) approach. And the AAN will be the major concept of this device.

Methods:
This project will help to train and assist the six of the major shoulder-muscle groups: pectoralis major, deltoid, teres major, teres minor, infraspinatus, and supraspinatus. The patients will sit on the chair with wearing the device. The EMG electrodes will be placed for six muscle groups and obtain the signal from patients.

The prototype of the device is during testing stage. The concept of the design is to parallel each specifc mucsle by cables. Therefore the motion of the muscles could be simulated and assisted. The exoskeleton will be mounted onto the aluminium frame. With the degree of freedom to suit different angle and height of patients.

Figure 1 the 5th prototype of the shoulder exoskeleton

The patients will be requested to complete several simple motions, such as reaching for objects and feeding one self. The device will provide varied driven forces through the cables which depend on the data collected from the patient. The signals will be used to control the cable motors through a simple principle, where

$$F = KV_{emg}$$

The vector is the reading from the EMG signal and F is the forces that the cables will execute. The factor K is the amount of assistance after we consider the training strength for the patients. Finally, the patient will gain more assistance if the strength of EMG signal increases, which means the muscle strength is also increased with higher EMG signal, and the specific muscle is considered as trained.

Potential Implications:
Shoulder injures problems will cause inconvenience of many simple motions. The burden of shoulder could be unexpectedlly high for athletes such as javelin, badminton, volleyball, weightlifting etc. Furthermore, shoulder subluxation is a common cause of pain for post-stroke patients (between 16-72% of stroke patients). This project will provide a new approach to perform effective shoulder muscle training and improve the quality of life of the patients.

Reference:
[1] M. K. Habib, Handbook of Research on Advancements in Robotics and Mechatronics, IGI Global, 2014.
[2] Darwin Lau, Jpnathan Eden, Denny Oetomo,Saman K Halgamuge, "Musculoskeletal Static Workspace Analysis of the Human Shoulder as a Cable-Driven Robt," pp. 1-3, 1 2014.
[3] Darwin Lau, Denny Oetomo, Saman K. Halgamuge, "Generalized Modeling of Multilink Cable-Driven Manipulators With Arbitrary Routing Using the Cable-Routing Matrix," 10 2013.
[4] Jian S Dai, Matteo Zoppi, Xianwen Kong, "Advances in Reconfigurable Mechanisms and Robots I," 2012, pp. 620-630.
[5] Ying Mao, Xin Jin, Geetanjali Gera, John P Scholz, Sunil K Agrawal, Human movement training with a cable driven ARm EXoskeleton(CAREX), 2014.
[6] Ying Mao, Xin Jin , Sunil K. AgrawaL, Real-Time Estimation of Glenohumeral Joint Rotation Center With Cable-Driven Arm Exoskeleton (CAREX)—A Cable-Based Arm Exoskeleton, 2013.
[7] T. Nef, M. Guidali, V. Klamroth, and R. Riener, "ARMin-Exoskeleton for Stroke Rehabilitation", Proceedings of International Federation of Medical and Biological Engineering, vol. 25, no. 9, pp. 127-130, 2009

2-16

How Effective of Lower Limb Resistance Training to Elder Chinese in Pre-Sarcopenia and Sarcopenia Stage

Li-juan LU, Sheung-wai LAW
Department of Orthopaedics and Traumatology, The Chinese University of Hong Kong

Background and Objectives:
Sacropenia, recognized with declining muscle mass and strength with low physical performance by AWGS[1] in 2014 (Liang-Kung Chen et al, 2014), has been gradually realized as important ageing symptom which imposes a great risk of immobility, dependence, frailty, fall and fracture etc. leading to enormous hospital admission chance and home nursing health cost. Costs associated with sacropenia in US were estimated to 18.5 billion in 2000. (Angela WH HO et al, 2015).Asia, with an anticipated tripled aged population above 65 years old in 2050 (Minja Kim Choe et al, 2002), will have China dominate around 166 million aged people in 2020 (Dominic Bailey et al, 2012).According to AWGS, the prevalence of sacropenia in elder Chinese is 12.3% and 7.6%, men and women, respectively (Liang-Kung Chen et al, 2014).Hence, high priority and emergency are required to find an optimal solution for this ageing problem. Although various treatments were given in many studies, such as exercise, nutrition intervention and pharmacological treatment, etc. (Solomon CY Yu et al, 2015), high intensive resistance training is strongly recommended with more than 60% assurance (Porter, 2001). Therefore, we would like to explore how effective of lower limb resistance training is to elder Chinese people in pre-sarcopenia and sacropenia stage. Restricted research on Chinese lies in the reflection to make it practical locally.

Methods:
The study will focus on below parts:1. Distinctive sacropenia screening benchmark in Chinese (Liang-Kung Chen et al, 2014)2. Current treatment recommendation and why resistance training works 3. Evaluation on common lower limb resistance training types 4. Systematic review on lower limb resistance training effectiveness to Chinese Elderly: comparison and synthesis.

Main databases will be recruited, including but not limited to, PubMed, ScienceDirect, ResearchGate, Google, Bing, WHO, CUHK library etc. Relative studies will be selected based on the criteria for study type, participant group, intervention ways, and outcome measurements. To eliminate irrelevant results, the following criteria will be implemented: a) keywords “elder Chinese” will be accompanied by sarcopenia, low muscle strength, fall/fracture, lower limb resistance training and their synonyms, such as leg press etc.; b) duplicates and unconcerned topics will be excluded e.g. nutrient, younger adults, upper body and bone etc.; c) scope will be narrowed by the titles and abstracts d) thorough study will then be made with critical appraisal tools recommended by University of Australia (UNISA, 2016); e) multiple assessments will be deployed on a AMSTAR method (Beverley J Shea et al, 2008), and reinforced by tabulation, meta-analysis and plots based on statistical results, following by discussion and conclusion in the final stage.

Potential Implications:
Firstly, early identification of sarcopenia is crucial for prevention and intervention, therefore, following AWGS criteria will minimize discrepancy. Secondly, most resistance training trials are tested and followed only for periods ranged from 8 to 16 weeks (Porter, 2001) with a big strength recession as high as 32% after dis-training in 4 weeks (Maria A Fiatarone et al, 1990), thus it is necessary to examine its long-term effects, and if possible, to explore its combined effects with Tai Ji Quan,a local popular exercise (Zhu YQ et al, 2016) since an optimal systematic exercise type (Porter, 2001) is still in lack . Tai Ji Quan is proved to be a cost-effective useful exercise to prevent fall in Parkinson Disease (Fuzhong Li et al, 2015).Thirdly, due to variable urban and rural lifestyle (Langli Gao et al, 2015), adjusted sarcopenia screening criteria are strongly appealed in terms of cutting off value and available measurement instrument. In sum, an optimal lower-limb exercise type with pragmatic screening criteria would be the key concerns to reduce family and social health cost for sarcopenia.

1 AWGS:Asian Working Group for Sacropenia

Reference:
[1] Angela WH HO et al. (2015, Dec 18). Prevelance of Pre-sarcopenia and sarcopenia in Hong Kong Chinese geriatric patients with hip fracture and its correlation with different factors. *Hong Kong Medical Journal* .
[2] Beverley J Shea et al. (2008, OCT 29). AMSTAR is a reliable and valid measurement tool to assess the methodological quality of systematic reviews. *Journal of Clinical Epidemiology* , pp. 1013-1020.
[3] Dominic Bailey et al. (2012, Sep 20). *BBC NEWS Asia.* Retrieved OCT 10, 2016, from BBC: http://www.bbc.com/news/world-asia-19630110
[4] Fuzhong Li et al. (2015, July). Economic Evaluation of a Tai Ji Quan Intervention to Reduce Falls in People With Parkinson Disease, Oregon, 2008–2011. *PREVENTING CHRONIC DISEASE* .
[5] Langli Gao et al. (2015, Sep 15). Prevalence of Sarcopenia and Associated Factors in Chinese Community-Dwelling Elderly: Comparison Between Rural and Urban Areas. *JAMDA* .
[6] Liang-Kung Chen et al. (2014, Feb). Sarcopenia in Asia:Consensus Report of the Asian Working Group for Sarcopenia. *Journal of the American Medical Directors Association* .
[7] Maria A Fiatarone et al. (1990, June 13). High-Intensity Strength Training in Nonagenarians. *JAMA the Journal of the American Medical Assocation* , pp. 3029-3034.
[8] Minja Kim Choe et al. (2002). *Asia's Aging Population.* Honolulu, Hawaii: East-West Center.
[9] Porter, M. M. (2001). The Effects of Strength Training on Sarcopenia. *Canadian Society for Exercise Physiology* , pp. 123-141.
[10] Solomon CY Yu et al. (2015, Dec 29). Clinical Screening Tools for Sarcopenia and Its Management. *Current Gerontology and Geriatrics Research* .
[11] UNISA. (2016). *Critical Appraisal methods.* Retrieved OCT 9, 2016, from Uiversity of South Austrilia: www.unisa.edu.au/research/sansom-institute-for-health-research/research-at-the-sansom/research-concentrations/allied-health-evidence/resources/CAT
[12] Zhu YQ et al. (2016, Jan). Effect of Tai Ji Quan Training on Strength and Function of Lower Limbs in the Aged. *Zhongguo Zhong Xi Yi Jie He Za Zhi* , pp. 49-53.

2-17

The Effects of Current Virtual and Augmented Reality Technology on Walking Biomechanics

Aislinn Joan Campbell MACPHAIL[1], Ivan Pui-hung AU[1], Zoe Yau-shan CHAN[1], Janet Hanwen ZHANG[1], Roy Tze-hei CHEUNG[1]
[1] Gait & Motion Analysis Laboratory, Department of Rehabilitation Sciences, The Hong Kong Polytechnic University, Hong Kong

Objectives:
Virtual Reality (VR) has started to be explored for its potential use in healthcare, however, few have investigated the use of VR in gait retraining. Past research of this nature has utilized complex technology of limited availability and has demonstrated that a VR environment can induce postural instability in healthy adults [1,5,7]. Therefore, the use of VR in rehabilitation, particularly gait retraining, is currently limited due to patient accessibility, stability and comfort.

A potentially safer and more realistic alternative to VR is Augmented Reality (AR), which alters or adds to real-time video feed of the natural environment [4]. AR has been used successfully in rehabilitation, such as in improving the balance, muscle activity, muscle strength, and gait function of stroke victims [3,4].

If current VR technology is not yet refined enough for use in rehabilitation such as gait retraining, it is worthwhile to explore the efficacy of more fitting alternatives, such as AR. Therefore, the purpose of this study is to reveal the biomechanical differences that may arise between a VR, AR and natural environment. We hypothesize that there will be (1) significant differences in walking biomechanics between the VR and natural environment; and (2) no significant differences in walking biomechanics between the AR and natural environment.

Methods:
Based on the recommendation of a similar report [5], 20 subjects will be recruited for the present study. Subjects should be free from any pathology that might hinder independent walking. Subjects will be given a 10-minute acclimatization period on the treadmill at a self-selected speed [6]. The experimental procedures will be reviewed and approved by the concerning institutional review board and written consent will be obtained from all subjects prior to the experiment.

Reflective markers will be firmly affixed onto specific bony landmarks according to a previously established model [2]. Additional markers will be attached to the VR/AR mask (Samsung Gear VR) to track its movement. Marker trajectories will be recorded using an 8-camera motion capture system (Vicon, Oxford Metrics Group, UK) at 200 Hz. Subjects will walk with their usual shoes on an instrumented treadmill (AMTI, Watertown, MA, USA) in three conditions: (1) VR environment mimicking the real laboratory environment (2) natural environment of the laboratory; and (3) AR environment simulated through real-time video capture of the Samsung Gear VR. The test sequence will be randomized and data will be collected during the last 30 seconds of each 3-minute trial.

Kinematics data will be filtered at 6 Hz with forth order low-pass filter. Temporal spatial parameters such as stride width and stride length will be calculated using Vicon Polygon (version 4.2, Vicon, Oxford Metrics, Oxford, UK). One-way ANOVA will be used to analyze and compare the conditions using SPSS.22 (Chicago, IL, USA). The dependent variables in this study will be stride length, stride width, cadence, joint angle (of ankle, knee and hip), and center of mass.

Social Impact:
Traditional rehabilitation often involves repetitive movements leading patients to lose interest and motivation. Additionally, current treatment methods cannot always provide immediate feedback, which may, if provided in real time, speed up patient recovery. Both VR and AR are thought to be potential solutions to such issues provided that they are user-friendly. However, the results of past studies show that patient safety and comfort may be at risk in a VR environment. Therefore, this study may highlight the issues with current VR technology and provide the information needed to improve the technology further. Additionally, this study may provide evidence that AR technology using real-time video has potential presently.

Reference:
[1] A. Borrego, J. Latorre, R. Llorens, M. Alcañiz, & E. Noé Journal of Neuro-eng. and Rehabil. (2016) 13.
[2] B. Bonnechère, V. Sholukha, P. Salvia, M. Rooze, & S. Van Sint Jan, Gait & Posture (2014) 41.
[3] G.O. Jung, T.H. Moon, G.W. Park, & B.H. Lee, J. Phys. Ther. Sci. (2013) 25(2) 147
[4] H. Hondori, M. Khademi, L. Dodakian, S. Cramer, & L.C. Videira, Med. Meets Virtual Reality 20 (2013) 279-285.
[5] J. H. Hollman, R. H. Brey, T. J. Bang & K. R. Kaufman, Gait & Posture 26 (2007) 289-294.
[6] L.F. Reed, S.R. Urry & S.C. Wearing, BMS Musculoskeletal Disorders 14 (2013) 249-259.
[7] S. Yang, W.H. Hwang, Y.C. Tsai, F.K. Liu, L.F. Hsieh, & J.S. Chern, Am. J. Phys. Med. Rehabil., 90 (2011) 969-978.

2-18

Physical Literacy and Coaching: Comparing Coaches' and Student-athletes' Perceptions of Physical Literacy in Hong Kong Secondary Schools

Ming-hui LI[1], *Raymond Kim-wai SUM*[1]
[1] Department of Sports Science and Physical Education, The Chinese University of Hong Kong

Background:
Research on physical literacy (PL) has drawn increasing attention in recent years while rare studies have explored the relationship of PL and coaching. Undoubtedly, coaches are regarded as significant and influential individuals to athletes, particularly children and adolescents throughout their sporting career (Sandström, Linnér, & Stambulova, 2016). Coaches do not only help athletes improve in their professions through their practical coaching skills, but their characteristics also influence their coaching style, which affects the behavior and performance of athletes in various aspects (Hwang, 2008). An interesting issue but receiving no focus to date is that whether coaches' perceived PL will influence the coaching style of their own and coaching effectiveness on their athletes. The current study is designed as a preliminary research exploring status quo of coaches and their student-athletes' PL in Hong Kong and identifying predictable factors influencing coaching effectiveness.

Objectives:
The purpose of this study is therefore to compare the differences of coaches' and student-athletes self-perceptions of their physical literacy in Hong Kong secondary schools and examine factors (i.e. gender and previous experience) influencing coaches' and student-athletes' PL separately.

Methods:
Coaches and their student-athletes from Hong Kong secondary schools will participate in this study and complete the Perceived Physical Literacy Instrument (PPLI) (Sum et al., 2016) accordingly. It is hypothesized that years of coaching experience will negatively predict coaches' self-perceived physical literacy, and male coaches will report higher physical literacy than female coaches. Sport experience of student-athletes will positively predict their self-perceived physical literacy, and male student-athletes will report higher physical literacy than female student-athletes. Finally, on average, coaches' ratings of their self-perceived physical literacy will be significantly higher than their student-athletes' ratings of their self-perceived physical literacy.

Potential Implications:
a) Theoretically, the present research will fill the research gap that no studies investigating coaches' PL have yet been conducted in Hong Kong, thereby making the current work the first to investigate whether PL can be a contributor of coaching; b) Practically, in terms of coaching education or providing services to coaches, PL presents a brand new concept. This study will definitely popularize and increase focus on the concept of PL among coaching service institutions. Meanwhile, the research will benefit awareness of physical literacy of students and teachers in Hong Kong secondary schools and assist policy makers in promoting policy implementation. Further research should explore the strength of physical literacy on aspects of coaching effectiveness.

Reference:
[1] Hwang, S. (2008). *The predictive strength of emotional intelligence on coaching efficacy and leadership style of high school basketball head coaches.* Michigan State University, East Lansing.
[2] Sandström, E., Linnér, L., & Stambulova, N. B. (2016). Career profiles of athlete–coach relationships: Descriptions and interpretations. *International journal of Sports Science & Coaching*.
[3] Sum, R. K., Ha, A. S., Cheng, C. F., Chung, P. K., Yiu, K. T., Kuo, C. C., . . . Wang, F. J. (2016). Construction and Validation of a Perceived Physical Literacy Instrument for Physical Education Teachers. *Plos One, 11*(5), e0155610. doi:10.1371/journal.pone.0155610

2-19

Intention-driven Shoulder Rehabilitation for Targeted Neuro-muscular Training Using an Exo-musculoskeletal Robot

Hang-man YIP[1], Hang-hon CHENG[2], Kai-yu TONG[3], Darwin Tat-ming LAU[4],
[1] Division of Biomedical Engineering, Department of Electronic Engineering, The Chinese University of Hong Kong
[2] Department of Mechanical and Automation Engineering, The Chinese University of Hong Kong
[3] Division of Biomedical Engineering, Department of Electronic Engineering, The Chinese University of Hong Kong
[4] Department of Mechanical and Automation Engineering, The Chinese University of Hong Kong

Background:
This exo-musculoskeletal robot aims to perform muscle-specific training of human shoulder rehabilitation. Robot is driven by cables, where cables are arranged in parallel to wearer's muscles. By this arrangement, muscles can be trained individually instead of a gross motion. Also this robot will carry out intention-driven rehabilitation (IDR), which provides assistance force proportional to the strength of their electromyography(EMG) signals. This approach can train subjects' ability to generate stronger signals [1].

This is an ongoing project that that involves many researchers. This proposal mainly includes the preliminary development of EMG signal processing and cable arrangement. Robotic and mechanical section is responsible by another student.

Objectives:
The main objective of the project is to build a prototype of the said robot. This proposal is to:
1. Arrange cable and surface EMG electrodes in a proper position that will not interfere exo-skeleton robot movement.

2. Measure surface EMG signal and establish relationship between shoulder muscle signal and robot movement

3. Demonstrate pilot study on healthy human subjects

Methods:
1. Cables and eletrodes arrangement: There are six muscles groups involved: deltoid, pectoralis major, teres major, teres minor, infraspinatus and trapezius. Since robot's position is limited around shoulder, only upper trapezius will be included in the robot. Deltoid is divided into three sets (anterior, middle, posterior) for precise EMG measurement and robot control. In preliminary robot design, only deltoid sets will be tested because they are at the lateral part of shoulder which make their exoskeleton easiest to design.If deltoid can be controlled and measured successfully, more muscles will be added to achieve a comprehensive, all-round device. Ag-AgCl electrode is chosen for EMG measurement since it has less electrical noise than other equivalent metallic electrodes. [2]

2. For EMG measurement, signal will be passed from electrodes to amplifier and rectify circuit, then transmitted and processed on an Arduino board. There, a motor control signal will be output to Robot Operation System (ROS). ROS controls a series of motors which are called Myomuscle. Myomuscle are cable-actuator that can pull the cable and generate required amount of force. The force generated by motor is in proportion to the muscle strength (i.e. (t)=$Kp\boldsymbol{V}emg(t)$ [3], where $\boldsymbol{V}emmg$ contains the reading of EMG, gains Kp correspond to the amount of assistant after considering the effort from the subject). Each pair of electrodes corresponds to one set of muscle and one Myomuscle.

3. To verify the effectiveness of prototype, a group of 10 human subjects will use the prototype to assess IDR effects on shoulder. Each subject will use the prototype for 10 sessions of 30 minutes per session. During these sessions, subject is required to perform a designed set of shoulder motion trajectories. The trajectories will be selected to allow the activation of different muscle groups to be observed. EMG signals, cable forces and kinematic trajectory of the motion will be recorded to analyze whether the IDR approach trains specific muscles when different trajectories are being performed.

Potential Implications:
Shoulder injuries will decrease muscle strength and arm's range of motion. Hence patients may not be able to perform day-to-day motions like reaching and raising arms. This project provides a new solution for injured athletes to achieve faster, more precise recovery for individual muscles.

Reference:
[1] R. Son, K.Y. Tong, X.L. Hu, L. Li, Assistive Control System Using Continuous Myoelectric Signal in Robot-Aided Arm Training for Patients After Stroke. *IEEE Transactions on Neural System and Rehabilitation Engineering* 2008 Aug;16(4):371-9
[2] Jamal, M. Z. (2012). *Signal acquisition using surface EMG and circuit design considerations for robotic prosthesis*. INTECH Open Access Publisher.
[3] G. Rosati, P. Gallina, S. Masiero, and A. Rossi, Design of a New 5 d.o.f. Wire-Based Robot for Rehabilitation. *Proceedings of 9th International Conference on Rehabilitation* Robotics, pp.430-433, 2005
[4] Morey-Klapsing, G., Arampatzis, A., & Brüggemann, G. P. (2004). Choosing EMG parameters: comparison of different onset determination algorithms and EMG integrals in a joint stability study. *Clinical Biomechanics*, *19*(2), 196-201.
[5] Sella, G. E. (2007). Clinical Utilization of Surface Electromyography and Needle Electromyography: A Comparison of the Two Methodologies. *Biofeedback*, *35*(1).

NOTE

ACKNOWLEDGEMENT

Organizer

Supporting Organization

香港浸會大學
HONG KONG BAPTIST UNIVERSITY

香港教育大學
The Education University of Hong Kong

Department of Health and Physical Education

醫療科技及資訊學系
Department of Health Technology and Informatics

康復治療科學系
Department of Rehabilitation Sciences

SCHOOL OF PUBLIC HEALTH
THE UNIVERSITY OF HONG KONG
香港大學公共衞生學院

Diamond Sponsor

SANOFI

Sponsor

BAYER

Organizing Committee

Chairman:	Prof. Patrick YUNG
Vice-Chairman:	Prof. Raymond SUM
Deputy:	Prof. Kam-Ming MOK
Members:	Dr. Justin LEE
	Mr. Hardaway CHAN
	Miss. Kate YUNG
	Mr. Benjamin KWOK
Executive:	Miss. Wancy LO

Scientific & Award Committee

Chairman:	Dr. Lobo LOUIE
Vice-Chairman:	Dr. Justin LEE
Members:	Dr. Derwin CHAN
	Dr. Roy CHEUNG
	Dr. Gary MAK
	Dr. Parco, Ming-Fai SIU
	Dr. Raymond SO
	Prof. Raymond SUM
	Dr. Clare, Chung-Wah YU

(Alphabetize by last name)

堅持品質信念
柏域斯®伴您同行 守護生命

柏域斯®乃醫生處方藥物
詳情請向醫生查詢

明知可獲救 沒理由放手

眾所周知，選擇抗血小板藥物要十分小心，絕不可以亂試亂停用。要選擇有良好品質監控、眾多臨床驗證及最為心臟科專科醫生選用[1,2,3]的**原廠柏域斯®**。

- 全球逾一億人服用[4]
- 連續十六年全港最暢銷抗血小板藥物[5]

HK.CLO.15.11.02

(1) Specialist Registration (The Medical Council of Hong Kong) ver 2014-09-03
(2) sanofi-aventis Hong Kong Limited Sales Report 2015
(3) HKAPI Jan-Oct 2015 Report (4) Data on file (5)IMS data 2000-2015 Q2 (B01C class)

查詢熱線：(852) 3164 6133
www.sanofi.hk

SANOFI