



















- anterior cruciate ligament injury. *Journal of Orthopaedic & Sports Physical Therapy* **44**, 76-84.
- Marquez, G., Aguado, X., Alegre, L.M. and Fernandez-Del-Olmo, M. (2013) Neuromechanical adaptation induced by jumping on an elastic surface. *Journal of Electromyography and Kinesiology* **23**, 62-69.
- McCriskin, B.J., Cameron, K.L., Orr, J.D. and Waterman, B.R. (2015) Management and prevention of acute and chronic lateral ankle instability in athletic patient populations. *World Journal of Orthopaedic* **6**, 161-171.
- Nashner, L.M. (1977) Fixed patterns of rapid postural responses among leg muscles during stance. *Experimental Brain Research* **30**, 13-24.
- Needle, A.R., Palmer, J.A., Kesar, T.M., Binder-Macleod, S.A. and Swanik, C.B. (2013) Brain regulation of muscle tone in healthy and functionally unstable ankles. *Journal of Sport Rehabilitation* **22**, 202-211.
- Park, D.H. and Singh, D. (2014) Ankle Instability: Ankle Sprain. *European Surgical Orthopaedics and Traumatology* 3860-3689.
- Pietrosimone, B.G. and Gribble, P.A. (2012) Chronic ankle instability and corticomotor excitability of the fibularis longus muscle. *Journal of Athletic Training* **47**, 621-626.
- Pope, M., Chinn, L., Mullineaux, D., McKeon, P.O., Drewes, L. and Hertel, J. (2011) Spatial postural control alterations with chronic ankle instability. *Gait & Posture* **34**, 154-158.
- Rosen, A., Swanik, C., Thomas, S., Glutting, J., Knight, C. and Kaminski, T.W. (2013) Differences in lateral drop jumps from an unknown height among individuals with functional ankle instability. *Journal of Athletic Training* **48**, 773-781.
- Ruan, M. and Li, L. (2010) Approach run increases preactivation and eccentric phases muscle activity during drop jumps from different drop heights. *Journal of Electromyography and Kinesiology* **20**, 932-938.
- Shultz, S.J., Perrin, D.H., Adams, J.M., Arnold, B.L., Gansneder, B.M. and Granata, K.P. (2000) Assessment of neuromuscular response characteristics at the knee following a functional perturbation. *Journal of Electromyography and Kinesiology* **10**, 159-170.
- Sierra-Guzman, R., Jimenez, J.F., Ramirez, C., Esteban, P. and Abian-Vicen, J. (2017) Effects of Synchronous Whole Body Vibration Training on a Soft, Unstable Surface in Athletes with Chronic Ankle Instability. *International Journal of Sports Medicine* **38**, 447-455.
- Sinsurin, K., Vachalathiti, R., Jalayondeja, W. and Limroongreungrat, W. (2013) Different Sagittal Angles and Moments of Lower Extremity Joints during Single-leg Jump Landing among Various Directions in Basketball and Volleyball Athletes. *Journal of Physical Therapy Science* **25**, 1109-1113.
- Son, S.J., Kim, H., Seeley, M.K. and Hopkins, J.T. (2017) Movement Strategies among Groups of Chronic Ankle Instability, Coper, and Control. *Medicine and Science in Sports and Exercise* **49**, 1649-1661.
- Steib, S., Zech, A., Hentschke, C. and Pfeifer, K. (2013) Fatigue-induced alterations of static and dynamic postural control in athletes with a history of ankle sprain. *Journal of Athletic Training* **48**, 203-208.
- Stormont, D.M., Morrey, B.F., An, K.N. and Cass, J.R. (1985) Stability of the loaded ankle. Relation between articular restraint and primary and secondary static restraints. *American Journal of Sports Medicine* **13**, 295-300.
- Tashman, S., Collon, D., Anderson, K., Kolowich, P. and Anderst, W. (2004) Abnormal rotational knee motion during running after anterior cruciate ligament reconstruction. *American Journal of Sports Medicine* **32**, 975-983.
- Terada, M., Bowker, S., Hiller, C., Thomas, A., Pietrosimone, B. and Gribble, P. (2017) Quantifying levels of function between different subgroups of chronic ankle instability. *Scandinavian Journal of Medicine and Science in Sports* **27**, 650-660.
- van Melick, N., Meddeler, B. M., Hoogeboom, T. J., Nijhuis-van der Sanden, M. W. G. and van Cingel, R. E. H. (2017) How to determine leg dominance: The agreement between self-reported and observed performance in healthy adults. *PLoS One* **12**, e0189876.
- Waterman, B. R., Owens, B. D., Davey, S., Zacchilli, M. A. and Belmont Jr, P. J. (2010) The epidemiology of ankle sprains in the United States. *The Journal of Bone & Joint Surgery* **92**, 2279-2284.
- Wikstrom, E.A. and Brown, C.N. (2013) Minimum Reporting Standards for Copers in Chronic Ankle Instability Research. *Sports Medicine* **44**, 251-268
- Wilkerson, G.B., Pinerola, J.J. and Caturano, R.W. (1997) Invertor vs. evertor peak torque and power deficiencies associated with lateral ankle ligament injury. *Journal of Orthopaedic & Sports Physical Therapy* **26**, 78-86.
- Willems, T.M., Witvrouw, E., Delbaere, K., Mahieu, N., De Bourdeaudhuij, L. and De Clercq, D. (2005) Intrinsic risk factors for inversion ankle sprains in male subjects: a prospective study. *American Journal of Sports Medicine* **33**, 415-423.
- Witchalls, J., Blanch, P., Waddington, G. and Adams, R. (2012) Intrinsic functional deficits associated with increased risk of ankle injuries: a systematic review with meta-analysis. *British Journal of Sports Medicine* **46**, 515-523.
- Wu, G., Siegler, S., Allard, P., Kirtley, C., Leardini, A., Rosenbaum, D., Whittle, M., D D'Lima, D., Cristofolini, L. and Witte, H. (2002) ISB recommendation on definitions of joint coordinate system of various joints for the reporting of human joint motion-part I: ankle, hip, and spine. *Journal of Biomechanics*, **35**, 543-548.
- Yeung, M. S., Chan, K. M., So, C. H. and Yuan, W. Y. (1994) An epidemiological survey on ankle sprain. *British Journal of Sports Medicine* **28**, 112-126.

### Key points

- CAI athletes utilize more multi-joint or multi-muscle strategies during landing to maintain stability and prevent re-injury.
- CAI weaker control of ankle stability increases higher angular velocity during ankle inversion, possibly a key contributor to the recurrence of injuries.
- CAI athletes and coper athletes had significantly lower peripheral ankle muscle activation than healthy athletes.

### AUTHOR BIOGRAPHY



#### Jian-Zhi LIN Employment

Department of Physical Education, National Taiwan Normal University, Taiwan

**Degree**  
PhD

#### Research interests

Clinical biomechanics with a specific focus on ACL injuries, ankle sprains, chronic ankle instability

**E-mail:** 102027@ntnu.edu.tw



#### Yu-An LIN Employment

Department of Physical Education, National Taiwan Normal University, Taiwan

**Degree**  
MSc

#### Research interests

Athlete monitoring, Neuromuscular performance

**E-mail:** bruce184184@gmail.com

**Heng-Ju LEE****Employment**

Department of Physical Education, National Taiwan Normal University,

**Degree**

PhD

**Research interests**

Clinical motion analysis, Athlete performance, Sport biomechanics

**E-mail:** [hjlee@ntnu.edu.tw](mailto:hjlee@ntnu.edu.tw)

✉ **Heng-Ju Lee, PhD, ATC.**

Department of Physical Education, National Taiwan Normal University, 88, Sec. 4, TingChou Rd, Taipei, Taiwan 11677