THE MYTH OF PROPRIOCEPTION

2 DAY WORKSHOP – CEU'S PROVIDED

Learn what the NATA, NSCA, EXOS and Perform Better has been raving about

WHEN

June 8-9, 2019

Saturday: 9am – 5pm
Sunday: 8am – 4pm

WHERE

College of Marin Athletics (San Francisco, California)

KENTFIELD CAMPUS, 835 COLLEGE AVENUE, KENTFIELD, CA 94904

https://www.google.com/maps/place/College+of+Marin+Library+at+Kentfield+Campus/@37.954742 9,-122.5490072,15z/data=!4m5!3m4!1s0x0:0xc3a84b08f6eb2f91!8m2!3d37.9547429!4d-122.5490072

FEATURING

Guido Van Ryssegem, MS, ATC, CSCS, NBFE, RN, International Presenter

REGISTRATION

http://athletics.marin.edu/information/athletic_training

or Call Joe Scarcella, (510) 823-6764

EARLY REGISTRATION

$499.00
Students $299.00

AT THE DOOR

$599.00

WHAT

This hands-on workshop reviews the scientific literature and advanced exercise strategies related to proprioceptive exercises.

As exercises are prescribed to improve balance or proprioception a clear understanding of what proprioception, balance and proprioceptive exercises really are is needed.

ABOUT THE INSTRUCTOR

Guido Van Ryssegem, ATC, CSCS, NBFE, RN has been in clinical practice for 35 years and has been working in the strength and conditioning field for 26 years. Guido has a wide range of expertise including his own movement dysfunctions restoration system, his movement variability, proprioception, sensorymotor, applied motor control and motor learning certifications for the health and exercise professional https://www.facebook.com/kineticintegrations.

2012 NATA National Service Award recipient.

He is a lecturer at national and international universities, as also private institutions. He has published in international journals and is a reviewer for the Journal of Back and Musculoskeletal Rehabilitation. He is a guest presenter for EXOS, the Perform Better Summits and MedBridge Education.

He has presented for the National Athletic Trainer Association (NATA), the National Strength and Conditioning Association (NSCA) and the American College of Sports Medicine (ACSM). Guido has been a keynote speaker at the ACSM Exercise is Medicine, the Bangkok 6th Institute of Physical Education International Conference, China FIT and the Korean Major League Baseball Conference and their Exercise Science Conference.

He has practiced for the Kansas City Royals, Texas Rangers, the Baltimore Orioles professional baseball teams and Oregon State University.

Guido was active within the NSCA as the coordinator for their Northwest Region and has served on committees. Within the NATA he has been active on committees, and national task forces.

Guido is also the Chief Product Officer of Elevation Fitness (https://elevationfit.com), an online exercise database management system, and is the director of the China Sports Medicine and Performance Academy, a private university in Beijing, China.

ABOUT THE INSTRUCTOR

Guido Van Ryssegem, has been in clinical practice for 35 years and has been working in the strength and conditioning field for 26 years. Guido has a wide range of expertise including his own movement dysfunctions restoration system, his movement variability, proprioception, sensorymotor, applied motor control and motor learning certifications for the health and exercise professional https://www.facebook.com/kineticintegrations.

Guido is the 2012 NATA National Service Award recipient.

He is a lecturer at national and international universities, as also private institutions. He has published in international journals and is a reviewer for the Journal of Back and Musculoskeletal Rehabilitation. He is a guest presenter for EXOS, the Perform Better Summits and MedBridge Education.

He has presented for the National Athletic Trainer Association (NATA), the National Strength and Conditioning Association (NSCA) and the American College of Sports Medicine (ACSM). Guido has been a keynote speaker at the ACSM Exercise is Medicine, the Bangkok 6th Institute of Physical Education International Conference, China FIT and the Korean Major League Baseball Conference and their Exercise Science Conference.

He has practiced for the Kansas City Royals, Texas Rangers, the Baltimore Orioles professional baseball teams and Oregon State University.

Guido was active within the NSCA as the coordinator for their Northwest Region and has served on committees. Within the NATA he has been active on committees, and national task forces.

Guido is also the Chief Product Officer of Elevation Fitness (https://elevationfit.com), an online exercise database management system, and is the director of the China Sports Medicine and Performance Academy, a private university in Beijing, China.

"This workshop totally changed all my patient's exercises"

"I wish my college instructors would take this workshop"

"The most comprehensive neuroscience workshop ever"

"The practical and theoretical knowledge gained from this workshop is something I will continue to use for the rest of my life. It will revolutionize the way you think about injury, rehab, and performance"

College of Marin Athletics

Learning Objectives

- **Participants will describe how proprioception is defined.**
- **Participants will describe how balance is defined.**
- **Participants will describe how postural control is defined.**
- **Participants will distinguish the difference between proprioception and balance.**
- **Participants will describe the relationship between proprioception and balance.**
- **Participants will identify that proprioception cannot improve.**
- **Participants will describe the role of the central nervous system towards proprioception.**
- **Participants will describe that movement variability is an essential feature of human motor behavior as it affords the necessary flexibility and adaptability to be successful in a variety of performances.**
- **Participants will apply exercise interventions to augment performance or injury outcomes.**

Program Gap

Because of lack adequate knowledge and appropriate skill, clinicians and exercise professionals often apply balance and proprioceptive concepts and exercise strategies intermittently with their populations.

Although proprioception and balance have been extensively described within the scientific literature, it is questionable if proprioception can even improve http://www.ufjf.br/especializacaofisioto/files/2013/06/Can-proprioception-really-be-improved-by-exercises1.pdf

This workshop is designed to improve the participants' competence related to proprioception and augment their skill level and skill application to improve their populations outcome in injury prevention, rehabilitation and performance.

Proprioception – Science and Practical Application

Guido Van Ryssegem.
Safe Recovery, LLC, Corvallis, Oregon, USA

Abstract

Recently so-called proprioceptive exercises have become very popular and have influenced the way exercise and rehabilitation professionals prevent, rehabilitate and augment performance. Additionally, several have claimed that balance and proprioceptive exercises improve proprioception. Not only do we find that the words 'balance' and 'proprioception' are used interchangeably in the literature, its exercise strategies and research measurements are applied interchangeably as well. As exercises are prescribed as an intervention to influence balance and proprioception a clear understanding of what proprioception, balance and proprioceptive exercises are is needed.

This abstract provides a short review of the literature related to proprioception and balance, what its relationship is to injury and performance, how the concepts related to proprioception theories and research can be manipulated so performance or return to performance can be improved. Exercise recommendations are brought forward.

Key Words: proprioception, balance, proprioceptive exercises, postural control

INTRODUCTION

As rehabilitation and exercise professionals started to appreciate concepts related to proprioception and balance, so called proprioceptive exercises became a popular intervention. It is the author's opinion that through this popularity people have ignored to examine what proprioception really is, what balance really is and what their relationships are to performance and injury (1). Simultaneously, by not respecting what proprioception and balance is, exercise intervention strategies should be questioned and examined (1).

As balance control is a motor control process (2) we must wonder that it is inherent to proprioception and wonder if proprioception can be improved by exercise at all (3).

The purpose of this paper is to review what proprioception is, what balance and postural control is, what their relationships are and how proprioception can be improved if at all.

Defining Balance and Proprioception

Although human balance is often described from a static perspective (19-20) even during quite standing (20) body movement is inevitable as inherent ability to control of relative position of the center of gravity (COG) and the center of pressure (COP) occurs as postural control is challenged (19-20).

Human balance can be further defined as the inherent ability of cognitive and reflexive control of the relative position of its COG and base of support (BOS) in order to maintain postural stability against intrinsic and extrinsic challenges (1). Maintaining balance is thereby a process of motor control, in order to maintain postural control in various challenging tasks (19).

Proprioception is often defined as sensory information about limb, trunk, and head position and movement (11, 19). It is thought to include self-perception of body's segmental position and movement, which can be processed to elicit reflexive and cognitive control of postural and joint stability (22).

Improvement of Proprioception

Until recent, researchers have reported that proprioception improved through exercises (4-6). But the problem is that they measured balance to evaluate proprioceptive function (7-10). Additionally, their interventions are questionable as they targeted improvements in balance, strength and postural control. It appears that proprioception improves as a result of exercise (11-15), while others reported no improvement at all (16-18) even if similar intervention strategies were used.

Based on the research above, the author concludes that proprioception is a sense that cannot improve, while balance and thereby postural control is a strategy (23) and can thereby improve through appropriate interventions.

Proprioceptive Training

Unstable surface training has often been claimed to improve proprioception (14), often under the assumption that unstable surface experiences challenge the proprioceptors and the central nervous system (CNS) and augment proprioceptive deficits post-injury (24). Unstable surface training seems beneficial for those that suffered of ankle functional instability creating speculation that balance impairment was caused by alteration in sensorymotor function (3, 14, 25-30).

Premature assumptions that one can train proprioception simply by stimulating proprioceptors, and that proprioceptive improvement will enhance balance ability as a whole can seriously mislead the rehabilitation and exercise experts. It is important to keep in mind that the feasibility of proprioceptive training is greatly challenged due to the lack of neurophysiological evidence (3).

If proprioception can be improved as claimed by some, then we must speculate that its interventions improve either the acquisition of the mechanical stimulus, positively effects the conversion of that signal into the neural signal and/or the transmission of that signal to the central nervous system (14). But, the velocity of the signal conversion is known to be fixed (31). Improved signal acuity of muscle spindles has been speculated to be possible. Theoretically, spindle acuity can be volitionally modulated through a task-dependent muscle contraction (3). An increase in spindle fusimotor drive, along with increased skeletomotor drive, has been observed (32-33). However, this is not evidence of an increase in proprioception per se, because the related experiments were not designed to test a hypothesis that increased fusimotor firing rate resulted in increase of proprioception.

The Role of the Central Nervous System Adaptation Induced Motor Learning in Balance Improvement

Establishing adequate motor behavior through CNS adaptation is necessary to successfully avoid joint injuries and falling. According to the Schmidt's generalized motor program theory (41), the CNS stores motor programs for each set of movement pattern and retrieves the programs when needed (41). The dynamic pattern theory opposes motor program-based theory. According to the dynamic pattern theory, movement coordination is controlled based on information from the environment and the dynamic properties of the body and limbs (21). This approach emphasizes the ability of nervous system to self-organize motor patterns. As both theories are supported by evidence, the author proposes that ideal

balance exercise programs should respect memory function as also respects the training effects of specific tasks and variety of environmental exposure, so task specific learning and movement emergence are augmented.

In order to provide an ideal training environment for CNS adaptation to occur, one should also consider the inherent limitation of the CNS to engage in multiple tasks at once (21).

It is suggested that the CNS attends to what matters and disregards irrelevant stimuli when performing motor skills (3). But it is clear that our brain can perform more than one activity at once as seen in daily life challenges such as walking and texting simultaneously.

According to Schmidt and Lee (31), the term dual- task interference refers to the decrement in performance of one or both tasks when two activities are carried out concurrently.

Two schools of thoughts exist from which distinctive training methodologies originate. One theory explains that the CNS overcomes dual task interference by mastering single-component tasks (34). With practice, a skill may become more automatic. With greater automaticity, the attentional demand of the same task is reduced. As a result, there are more CNS resources available for a secondary task. Therefore, this theory emphasizes separate practice of component tasks. Another theory discusses that practice leads the CNS to integrate different tasks together so that the CNS can perceive the two different tasks as a single higher order skill (28). This helps the CNS to overcome dual task interference because tasks that were previously recognized as dual-tasks become recognized as single-tasks. Therefore, this theory emphasizes simultaneous dual task training.

Silsupadol et al. (35) combined the two theories mentioned above and created a dual task balance training methodology. Three different balance training methods were compared: a single task balance training task, a combined balance and cognitive task under a fixed-priority instructional set, and a combined balance and cognitive task under a variable-priority instructional set.

Only the participants who trained under variable instructional set showed improvement of balance during the balance performance with novel cognitive tasks. This benefit was maintained for 3 months. This result indicates that simultaneous training of dual task with intentional shift of attention between balance and cognitive tasks is most effective in transferring the training effect to real life situations.

Dual task training is not always the best methodology of training motor skill though, as researchers suggest that skill focused attention is important during the initial stage of motor learning but becomes counterproductive for the experienced individuals (36-39). Researchers showed that multiple task training were more effective for performance developments of experienced athletes (36,38). Intuitively, this indicates that cognitive attention is productive for training novice but certain amount of distraction from it is necessary to help experienced individuals proceed to more advanced level. Circumstantial evidence can be found in performance of professional athletes. Their practice and competition are full of continuous cognitive and motor task on top of the balance performance. The author speculates that these multiple tasks continuously give dual task interference challenge to the CNS. As athletes repeat the practice, the CNS finally learns how to maintain balance despite multiple environmental distractions.

Conclusion

So-called proprioceptive training methods in rehabilitation and strength and performance settings are common. While it is encouraged to continue such methods, scientific evidence does not necessarily proof its efficacy (1).

Proprioception is sometimes mistakenly considered as a key factor to improve or restore human balance and to prevent injury. However, there is no neurophysiological evidence that proprioception can be improved (2). If exercise interventions are applied to augment the proprioceptors sensitivity, then interventions should distinctively target a variety of motor skills (3). Also, strategies should target the CNS to overcome its limited attentional capacity by adequately imposing multiple task demands (28, 34).

More research is needed to identify what proprioception is, so its components can be agreed upon. In the mean while rehabilitation and exercise professionals should be thoughtful in their claims and their intervention strategies (1).

References

1. Kim, D., Van Ryssegem, G., Hong, J. (2011) Overcoming the myth of proprioceptive training. *Clinical Kinesiology* (65)1; Spring 2011.
2. Horak, F.B. Postural orientation and equilibrium: what do we need to know about neural control of balance to prevent falls? *Age Ageing.* 35(Suppl 2): ii7–ii11, 2006.
3. Ashton-Miller, J.A., E.M. Wojtys, L.J. Huston, and D. Fry-Welch. Can proprioception really be improved by exercise? *Knee Surg, Sports Traumatol, Arthrosc.* 9:128-136, 2001.
4. Hupperets, M.D., E.A. Verhagen, W. van Mechelen. Effect of unsupervised home-based proprioceptive training on recurrences of ankle sprain: randomized controlled trial. *BMJ* 339: b2684, 2009.
5. Jan, M.H., P.F. Tang, J.J. Lin, S.C. Tseng, Y.F. Lin, and D.H. Lin. Efficacy of a target-matching foot-stepping exercise on proprioception and function in patients with knee osteoarthritis. *J Orthop Sports Phys Ther.* 38(1):19-25, 2008.
6. Loudon, J.K., M.J. Santos, L. Franks, and et al. The effectiveness of active exercise as an intervention for functional ankle instability: A systematic review. *Sports Med* 38:553–63, 2008.
7. De Carlo M.B., and R.W. Talbot. Evaluation of ankle joint proprioception following injection of the anterior talofibular ligament. *J Orthop Sports Phys Therapy.* 70-6, 1986.
8. Calmels P., M. Escafit, M. Domenach, and P. Minaire. Posturographic evaluation of the proprioceptive effect of ankle orthoses in healthy volunteers. *Int Disabil Stud* 13:42-5, 1991.
9. Mattacola C.G., and J.W. Lloyd. Effects of a 6-week strength and proprioception training program on measures of dynamic balance: a single-case design. *J Athl Train.* 32:127–135, 1997.
10. Fu A.S., and C.W. Hui-Chan. Ankle joint proprioception and postural control in basketball players with bilateral ankle sprains. *Am J Sports Med.* 33: 1174-1182, 2005.
11. Horak, F.B. Postural orientation and equilibrium: what do we need to know about neural control of balance to prevent falls? *Age Ageing.* 35(Suppl 2): ii7–ii11, 2006.
12. Hughes, T., and R. Patsy. The effects of proprioceptive exercise and taping on proprioception in subjects with functional ankle instability: A review of the literature. *Phys Ther Sport.* 9(3): 136-147, 2008.
13. Ilg, R., A.M. Wohlschlager, C. Gaser, and et al. Gray matter increase induced by practice correlates with task-specific activation: a combined functional and morphometric magnetic resonance imaging study. *J Neurosci.* 28(16): 4210–4215, 2008.
14. Lephart, S.M., and F.H. Fu. Proprioception and neuromuscular control in joint stability. Human Kinetics. 2000.
15. Mattacola C.G., and J.W. Lloyd. Effects of a 6-week strength and proprioception training program on measures of dynamic balance: a single-case design. *J Athl Train.* 32:127–135, 1997.
16. Refshauge, K.M., Kilbreath, S.L., and Raymond, J. The effect of recurrent ankle sprains and taping on proprioception at the ankle, *Med and Science in Sports and Exercise*, 32, 10-15, 2000.
17. Westlake, K.P. and E.G. Culham. Sensory-specific balance training in older adults: Effect on proprioceptive reintegration and cognitive demands. *Physical Therapy* 87 (10): 1274-83, 2007.

18. Kiers, H., Brumagne, S., van Dieen, J., van der Wees, P., and Vanhees, L. Ankle proprioception is no targeted by exercise on an unstable surface. *Eur J Appl Physiol*. 112: 1577-85, 2012.
19. Pollock, A.S., Durward, B.R., Rowe, P.J., and Paul, J.P. What is balance? *Clin Rehabil*. 14: 402–406, 2000.
20. Winter, D.A. Human balance and posture control during standing and walking. *Gait Posture*. 3: 193-214, 1995.
21. Magill, R.A. Motor learning and control: concepts and application. (9th ed.). New York, NY: McGraw-Hill, 2010.
22. Riemann, B.L. and Lephart, S. M. The sensorymotor system, Part 1: The physiologic basis of functional joint stability. *J Athl Train.* (37)1: 71-79, 2002.
23. Shumway-Cook, A., and Woollacott, M.H. *Motor Control*. Philadelphia, Pennsylvania. 2001.
24. Schmidhammer, R., Hausner, T., Hopf, R., Zandieh, S. and Redl, H. In peripheral nerve regeneration environment enriched with activity stimulating factors improves functional recovery. *Acta Neurochir Suppl.* 100:161–167, 2007.
25. Freeman, M.A.R., Dean, M.R.E, and Hanham, I.W.F. The Etiology and Prevention of Functional Instability of the Foot. *J Bone Joint Surg Am*. 47B (4): 678-85, 1965.
26. Hertel, J. Functional instability following lateral ankle sprain. *Sports Med.* 29(5): 361-371, 2000.
27. Mandelbaum, B.R., Silvers, H.J., Watanabe, D.S., and et al. Effectiveness of a Neuromuscular and Proprioceptive Training Program in Preventing Anterior Cruciate Ligament Injuries in Female Athletes: 2-Year Follow-up. *Am. J. Sports Med.* 33: 1003-1010, 2005.
28. Munn, J., Sullivan, S.J., and Schneiders, A.G. Evidence of sensorimotor deficits in functional ankle instability: A systematic review with meta- analysis. *J Sci Med Sport*.13(1): 2-12, 2009.
29. Ross, S.E., and Guskiewicz, K.M. Examination of Static and Dynamic Postural Stability in Individuals with Functionally Stable and Unstable Ankles. *Clin J Sport Med.* 14(6): 332- 338, 2004.
30. Rozzi, S.L., Lephart, S.M., Sterner, R., and Kuligowski, L. Balance training for persons with functionally unstable ankles. *J Orthop Sports Phys Ther* . 29(8) :478-86, 1999.
31. Schmidt, R.A., and Lee, T.D. *Motor control and learning. A behavioral emphasis* (4th ed.). Champaign, IL: Human Kinetics, 2005.
32. Sjölander, P., and Johansson, H. Sensory endings in ligaments: response properties and effects on proprioception and motor control. In: Yahia L(ed) *Ligaments and ligamentoplastics*. Springer, Berlin Heidelberg New York, 39–83, 1997.
33. Gandevia, S.C., D.I. McCloskey, and D. Burke. Kinesthetic signals and muscle contraction. *Trends Neurosci*. 15: 62–65, 1992.
34. Woollacott, M.H., and Shumway-Cook, A. Attention and the control of posture and gait: A review of an emerging area of research. *Gait Posture.*16: 1–14, 2002.
35. Silsupadol, P., Siu, K., Shumway-Cook, A., and Woollacott, M.H. Training of balance under single and dual-task conditions in older adults with balance impairment. *Phys Ther.* 86: 269 – 281, 2006.
36. Beilock, S.L., Carr, T.H., MacMahon, C., Starkes, J. L. When Paying Attention Becomes Counterproductive: Impact of Divided Versus Skill-Focused Attention on Novice and Experienced Performance of Sensorimotor Skills. *J Exp Psychol.* 8(1): 6–16, 2002.
37. Gray, R. Attending to the execution of a complex sensorimotor skill: Expertise differences, choking, and slumps. *J Exp Psychol: Applied.* 10: 42-54, 2004.
38. McPherson, S.L. Expert-novice differences in planning strategies during collegiate singles tennis competition. *Journal of Sport and Exercise Psychology*. 22: 39–62, 2000.
39. Robertson, S.D., Zelaznik, H.N., Lantero, D.A., Bojczyk, K.G., Doffin, J.G., and Schneidt, T. Correlations for timing consistency among tapping and drawing tasks: Evidence against a single

timing process in motor control. *J Exp Psychol: Human perception and performance.* 25: 1316-1330, 1999.