EFFECT OF COMBINED LOCAL TOPICAL ANESTHESIA AND PHYSICAL ACTIVITY ON KNEE PROPRIOCEPTION SENSES, AND STATIC BALANCE IN HEALTHY YOUNG INDIVIDUALS

Khalil Khayambashi, Javad Baharlue, Shahram Lenjannejadian

College of Physical Education and Sport Sciences, Isfahan University, Isfahan, Islamic Republic of Iran

Sixty males participated in this investigation and were randomly assigned into four groups. Group one received only local topical anesthesia on the dominant knee. Second group performed 10 min. sub-maximal running on treadmill with speed of 8 km/h. Third group received local topical anesthesia, the same as group one, combined with 10 min. sub-maximal running. Fourth group served as a control group. The knee proprioception senses for active and passive repositioning, and quadriceps, hamstring maximal torque were measured using Biodex Isokinetic Dynamometer. A single leg stance balance test was used to measure static balance. Findings revealed two interesting results. First; 10 min. sub-maximal running improved knee passive repositioning; second; after 10 min. sub-maximal running static balance declined.

KEYWORDS: proprioception, static balance, topical anesthesia.

INTRODUCTION: The complexity of joint motion requires joint stability especially in the movement which sudden and fast change in joint motion is necessary. Joint stability combined with smooth coordinated movement requires synchrony of agonist and antagonist muscles contraction. Proprioception information is collective neural input from joint capsules, ligaments, muscles, tendon, skin, and mechanoreceptors which provide neuromuscular coordination to protect the joint from injury, by using the appropriate balance of synergistic and antagonistic forces. Proprioception information also have important role to maintain good balance and posture. Balance requires proper information from sensory input, effective processing by the CNS, and appropriate responses of motor control (Kauffman et. al, 1997). The CNS relies on information from three sensory systems for maintaining balance. Proprioception, visual, and vestibular. input provides information about the orientation of the body and body parts relative to each other and the base of support. Information is received from joint and skin receptors, deep pressure and muscle proprioception (Hobeika, 1999; Horak, 1994). Proprioception cues are dominant inputs for maintaining balance when the support surface is firm and fixed (Hobeika, 1999; Dietz 1980).
Muscle spindles have been regarded as the most important among proprioceptors, however in recent year's skin mechanoreceptors role became increasingly apparent (Edin, 2001). Neurophysiologic evidence that afferent information from skin receptors is important for proprioception has been gathered mainly in experiments relating to the human hand and finger joint (Collins et al., 2005). Receptors in the hairy skin of humans can provide high-fidelity information about knee joint movement (Edin, 2001). Clinical data suggest that information from skin mechanoreceptor is valuable for joint stability. Physical therapists have claimed that taping a joint improves its stability. Taping large joints such as the knee hardly makes any mechanical support. However the ability of the organism to control the muscle acting on the joint may be due to altered somatosensory inflow from the skin (Edin, 2001).
Sport injuries are unwanted part of the game. Topical anesthesias have been often used to numb the pain of injured limb in order to help the athlete to continue participation in the game. Topical anesthesia is a liodcane analgesic medication which is easily absorbed by the skin and provides local numbness to the area of application. Warm up before physical activity improve proprioception (Subasi et al., 2008) while fatigue decreases propriocetion capability (Surenkok et al., 2006). It is unclear if using topical anesthesia followed with physical activity which simulates real game situation would have impact on receptors in the skin, proprioception, and static balance. The purpose of this study was to assess the effect of combined local topical anesthesia and physical activity on knee proprioception senses, static balance, and quadriceps and

hamstring maximum torque.

METHOD: Sixty male physical education students (age 22.1±3.6 years, height 177.4±5.4cm, weight 70.7± 10.6 kg) from participated in this investigation. Subjects were free from history of orthopedic problem in their dominant knee and ankle. They randomly assigned into four groups. Group one received only local topical anesthesia 10 cm below and 10 cm above and around dominant knee. Second group performed 10 min. sub maximal running on treadmill with speed of 8 km/h. Third group received local topical anesthesia the same as group one combined with 10 min. sub maximal running. Fourth group served as a control group. All subjects participated in pre and post tests. The knee proprioception senses for active and passive repositioning, and quadriceps, hamstring maximal torque were measured using Isokinetic Dynamometer Biodex System 3.Single leg stance balance test was used to measure static balance. Pared t-test and ANOVA was used to analysis the data.

RESULTS: The results are shown in Table 1. No significant differences were found in the knee proprioception senses, static balance and maximum quadriceps and hamstring torques post application of local anesthesia. After 10 min. sub maximal running the knee proprioception sense for passive repositioning improved significantly, while balance declined, and no significant differences were detected for quariceps and hamstring maximum torque. Combined application of local topical anesthesia and sub-maximal running improved knee proprioception for passive repositioning, but decreased static balance; and showed no significant effect on quadriceps and hamstring maximum torque. No significant differences were found between pre and post tests for knee proprioception, static balance, and quadriceps and hamstring maximum torque in control group. (P value of 0.05 was chosen).

Table 1. Pared t-test comparison between 3 groups

	Group 1 (topical anesthesia)		Group 2 (10 min running)		Group 3 (combined anesthesia & running)	
	t	p	t	p	t	p
Active joint	**-0.08**	**0.39**	**-0.69**	**0.49**	**-1.6**	**0.12**
Passive joint	0.07	0.94	2.69	0.018*	2.6	0.02*
Static Balance	-0.47	0.64	2.99	0.01*	2.4	0.02*
Quadriceps Maximal	-0.49	0.69	-0.048	0.96	-0.21	0.83
Hamstring Maximal	-1.8	0.08	-1.2	0.25	1.3	0.82

*(P<0.05)

DISCUSSION: Findings of this study revealed two interesting results. First; 10 min. sub-maximal running improved passive knee repositioning, while active repositioning did not change significantly. Muscle spindles are the first source of proprioception senses (Riemann et. al 2002); and there is a possibility that their roles are more important in passive than active movement (Subasi et. al 2008). Thus 10 min. sub maximal running could have acted as a medium to warm up the muscles and caused higher sensitivity of muscle spindles. Second; after 10 min. sub-maximal running static balance declined. In order to control balance one is more dependent on information from the lower leg and ankle musculature. In this case lower leg and ankle muscles fatigue might have been cause of static balance decline (Miura et. al 2004).

Application of local topical anesthesia did not show significant effect on knee proprioception and single leg stance balance. Skin mechanoreceptors are important in the human hand (Edin& Johansson, 1995) and face (Gracco & Abbs, 1985). Mechanoreceptors in joint ligaments and capsules may be crucial in extreme, but not necessarily noxious, joint position (Burke et al.1988; Edin, 1990). Temporally skin numbness by local topical anesthesia may be more effective to block pain receptors than the skin mechanoreceptors. There is also possibility that in gross movement of large joint such as knee, muscle spindle receptors are dominant and skin mechanoreceptor numbness has no impact on knee proprioception.

CONCLUSION: Based on the finding of this study local topical anesthesia has no effect on knee proprioception senses, static balance, and quadriceps and hamstring maximum torque. 10 min. sub maximal running improved knee proprioception sense but decreased static balance which could have been due to lower leg and ankle muscles fatigue.

REFERENCES:

Burke, D., Gandevia, S.C., Macefield, G (1988). Responses to passive movement of receptors in joint, skin and muscle of the human hand. Journal of Physiology 402:347–361.

Collins, D.F., Refshauge, K.M., Todd, G., Gandevia, S.C (2005). Cutaneous receptors contribute to kinesthesia at the index finger, elbow, and knee. J Neurophysiol, 94: 1699-1706.

Dietz, V., Horstmann, G.A., Berger, W (1980). Significant of proprioceptive mechanisms in the regulation of stance. Prog Brain Res, 80: 419-423.

Edin, B.B (2001). Cutaneous afferents provide information about knee joint movement in humans.The Journal of physiology, 531: 289-297.

Edin, B.B., Johansson, N (1995). Skin strain patterns provide kinaesthetic information to the human central nervous system. Journal of Physiology 487:243–251.

Edin, B.B (1990). Finger joint movement sensitivity of non-cutaneous mechanoreceptor afferents in the human radial nerve. Experimental Brain Research 82:417–422.

Gracco, V.L., Abbs, J.H (1985) .Dynamic control of the perioral system during speech: kinematic analyses of autogenic and nonautogenic sensorimotor processes. Journal of Neurophysiology 54:418–432.

Hobeika, C.P (1999). Equilibrium and balance in the elderly. ENT, 78: 558-556.

Horak, F.B., Shupert, C.L (1994). Role of the vestibular systems in postural control. SJ Herdman, ed. Vestibular rehabilitation. Philadelphia: 22-46.

Miura, K., Ishibashi, Y., Tsuda, E., Okamura, Y., Otsuka, H (2004). The effect of local and general fatigue on knee proprioception. The journal of Arthroscopic & Related Surgery, 20(4): 414 - 418.

Riemann, B.L and Lephart, S.M (2002). The Sensorimotor System, Part II: The Role of Proprioception in Motor Control and Functional Joint Stability. Journal of Athletic Training, 37(1): 8 0 -84.

Subasi, S.S., Gelecek, N & kasnakoglu, G (2008). Effect of different warm-up periods on knee proprioception and balance in healthy young individuals. Journal of Sport Rehabilitation, 17(2): 186 -205.

Surenkok, O., Isler, A.k., Aytar, A., Gultekin, Z and Akman, M.N (2006). Effect of knee muscle fatigue and lactic acid accumulation on balance in healthy subjects. Isokinetics and exercise science, 14: 301 -306.

Kauffman, T.L., Nashner, L.M., Allison, L.K (1997). Balance is a critical parameter in orthopedic rehabilitation. New technol Phys Ther, 6: 43-78.