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EFFECT OF ANKLE STABILIZERS ON SIDE SHUFFLE PERFORMANCE

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The purpose of this study was to examine the effect of ankle stabilizers on side shuffle performance. Eight healthy and active college students randomly performed six side shuffle trials in both directions; three without and three with an ankle stabilizer. Two dimensional (2D) kinematic and kinetic data were collected. The only significant difference was found in ankle ROM during braking and propulsive phases while traveling in both directions. All the kinetic data (impulses and peak forces in vertical and horizontal directions) were similar between conditions during braking and propulsive phases. Although the average horizontal velocity was slightly lower in the ankle stabilizer condition, the statistical significance was not met (P=0.06). The results suggested that semi-rigid ankle stabilizer had no significant effect on the side shuffle performance.

KEY WORDS: ankle stabilizer, ROM, side shuffle.

INTRODUCTION: Nearly two million ankle injuries are sustained annually (Ivins, 2006) and ankle sprains are the most prevalent type of injury in sports (Backx, Beijer, Bol, & Erich, 1991; Eils & Rosenbaum, 2001; Rosenbaum, Kamps, Bosch, Thorwesten, Volker, & Eils, 2005). The high occurrence of ankle sprains (10-28%; Garrick & Requa, 1988) is considered to be the most frequent reason for lost practice/playing time and long-term impairment (Garrick & Requa, 1988; Yeung, Chan, So, & Yuan, 1994). After an ankle injury, a variety of treatment options including taping and use of braces have been utilized to stabilize the ankle joint. Further, these techniques have been proven to be an effective preventative measure to avoid future injuries by restricting the ankle's range of motion (ROM) laterally (i.e., inversion and eversion; Osbourne & Rizzo, 2003; Papadopoulos, Nicolopoulos, Anderson, Curran, & Athanasopoulos, 2005). Athletes tend to prefer the prophylactic use of braces due to convenience (Garrick & Requa, 1973).Most studies in relation to ankle braces specifically focus on injury and/or re-injury reduction and recovery benefits (e.g., Lardenoye, Theunissen, Cleffken, Brink, de Bie, & Poeze, 2012; Nishikawa, Kurosaka, Mizuno, & Grabiner, 2000). While these stabilizers may reduce the risk of future recurrent ankle injuries, they may also have an effect on performance due to limited ROM. There are equivocal findings regarding the effects of ankle braces on sport performance which may be due to the various ankle braces utilized in the studies as well as the type of movement under investigation. While some studies found that effects of ankle braces on performance with previously injured individuals did not hinder sprinting performance (e.g., Gross et al., 1997), other research indicated that ankle stabilizers negatively affect agility related movements in the sagittal plane (Ambegaonkar, Redmond, Winter, Cortes, Ambegaonkar, Thompson, & Guyer, 2011).) Additionally, studies disclosed that peak medial-lateral ground reaction forces (PMGRF) were reduced and a decrease in ROM was observed with the presence of an ankle brace for cutting maneuvers (Cloak, Galloway, & Wyon, 2010; Gudibanda & Wang, 2007).

In summary, it appears that ankle stabilizers may negatively affect medial-lateral, but not anterior-posterior movements. Therefore, the major aim of this study was to examine the effects of a semi-rigid ankle stabilizer on side shuffle performance that is frequently executed in sports such as volleyball, table tennis, tennis, badminton, etc. Specifically, the study was designed to: 1) determine the differences in average velocity between conditions (with and without an ankle stabilizer), 2) determine changes in peak force and impulse in horizontal and vertical directions between conditions, 3) determine if ankle ROM is altered between conditions, and 4) ultimately provide findings on whether ankle stabilizers affect performance on medial-lateral movement.

METHODS: The participants in the study were comprised of eight healthy and active college student volunteers (age: 21.25 ± 1.39 years; height: 1.76 ± .07 m; body mass (BM): 77.76 ± 15.6 kg). The participants were instructed to warm-up by conducting several side shuffle trials. During the warm-up, the appropriate trial distance was marked in accordance to the stride length of each individual subject. Each participant performed 6 trials that were randomly assigned; 3 trials without an ankle stabilizer and 3 trials with a semi-rigid "ATF-2 ankle brace". The brace was worn on the dominant leg of the participant. Each subject took 5-minute and 2-minute breaks between conditions and trials, respectively. All the participants started their side shuffle by traveling toward their right first and reversed the side shuffle direction when they reached the marker. In each direction of the side shuffle, each participant was required to have their dominant leg step on the force platform once. The trials were discarded when the subjects exhibited internal and/or external rotation of the lower leg at any time.

A two-dimensional video analysis was performed to obtain the rear foot angle from the posterior view of the subject with a 60-Hz video camera in conjunction with a motion analysis system (Vicon Motus: 9.2).Three reflective markers were placed on the dominant leg of the participants: the first on the posterior side of the knee between the lateral and medial epicondyles, the second on the back of the ankle in between the medial and lateral malleolus, and the third on the bottom of the calcaneus. All the videos were cropped from the 10^{th} field before the first contact of the dominant leg on the force platform (traveled toward right) to the 10^{th} field after the second contact of the dominant leg on the force platform (traveled toward left). The fourth-order zero-lag Butterworth filter and a cut-off frequency (4 Hz) were performed to filter the kinematic data (Jackson, 1979). The force and kinematic data were synchronized by using Remote Video Synchronization Unit (RVSU).

The average velocity of the side shuffle for each trial was calculated by the distance traveled and the time used. The ROM and peak vertical and horizontal forces during braking and propulsive phases were obtained. Lastly, the horizontal and vertical impulses during the braking and propulsive phases were calculated. SPSS 15.0 was used to perform statistical analysis. Standard t-tests were performed to investigate the significant difference between conditions. In addition, the effect size and Cohen's *d* were calculated to show the strength of the statistical results. Holm's correction was applied to control type I error (Lundbrook, 1998).

RESULTS: Mean and standard deviation for each variable were provided in table 1 and 2. Significant differences were only found in ROM during braking and propulsive phases (Table 1). Even though the average horizontal velocity was slightly lower when wearing an ankle brace, the statistical significance level was not met (P = 0.06). There were no significant differences found between all other variables examined (Table 2).

Table 1

Phase	Braking*	Propulsive*
WO	6.08 ± 2.55	7.10 ± 3.35
W	4.75 ± 1.67	5.19 ± 2.20
Effect Size (ES)	0.3	0.32
Cohen's d (d)	0.62	0.68

Note: The ROM with (W) and without ankle brace (WO) in both braking and propulsive phases. * Indicates significance level met. Effect size (ES) and Cohen's d (*d*) were provided.

Table 2

Differences in major variables with and without a brace

Phase	Ave. V. (m/s)	Average Horizontal Impulse (BW.s)		Average Vertical Impulse (BW.s)		Average Peak Medial-Lateral Force (BW)		Average Peak Vertical Forces (BW)	
		Braking	Propulsive	Braking	Propulsive	Braking	Propulsive	Braking	Propulsive
WO Brace	1.34±.13	.05 ± .01	.09 ± .02	.23 ± .04	.26 ± .04	.83 ± .26	.72 ±.16	3.34 ±1.81	2.85±1.7
W Brace	1.28 ± .14	.06 ± .01	.09 ± .02	.23 ± .04	.31 ± .04	.80 ± .25	.67± .16	3.09± 1.34	2.31± .92
ES	0.23	-0.1	-0.02	-0.02	-0.15	0.05	0.08	0.08	0.19
d	0.46	-0.2	-0.04	-0.04	-0.31	0.09	0.17	0.16	0.39

Note: Trial data including average velocity (Ave. V.), average horizontal impulse, average vertical impulse, average peak medial lateral force, and average peak vertical forces in trials without brace (WO Brace) and with brace (W Brace).

DISCUSSION: The findings of this current study support that a semi-rigid ankle brace has minimal effect on side shuffle performance (Rosenbaum et al., 2005). The only significant difference was ankle joint ROM (inversion and eversion) during braking and propulsive phases in both directions. No significant differences were found in average horizontal velocity, peak GRF (vertical and medial-lateral), and impulses (horizontal and vertical).

The goal of a prophylactic ankle brace is to stabilize the ankle joint by decreasing the possibility of inversion and eversion sprains. The current study supported previous research which conclusively demonstrated the effects of braces by controlling the ROM of the ankle (Green & Hillman, 1990; Gross, Bradshaw, Ventry, & Weller, 1987; Osbourne & Rizzo, 2003; Papadopoulos et al., 2005). There is concern that the therapeutic benefits of an ankle brace may be disregarded if athletes believe that it may interfere with athletic activity (Ambegaonkar et al., 2011; Bot & van Mechelen, 1999) and thus, this intervention is likely to be ignored or abandoned. However, in multiple studies in which overall agility and performance were evaluated, no significant differences were found (Gross et al., 1997; Pienkowski, McMorrow, Shapiro, Caborn, & Stayton, 1995). Though the findings of this study in general supported previous research, the results were more specific with regard to comparable performance between conditions using horizontal and vertical impulses as well as peak horizontal and vertical forces during braking and propulsive phases for the side shuffle motion. An interesting finding was that average horizontal velocity was determined to be slightly slower (approaching statistical significance) in the brace condition than without a brace. Though this may not impact recreational players, this may result in a disadvantage for sports at the competitive level when greater horizontal velocity is required.

There are several limitations regarding this study. The first being the sample size was relatively small and could influence the power of the results. Second, this study used 2D motion analysis for the ankle angle ROM. Although there were methods attempted to control for the internal and external rotation of the lower leg and foot during side shuffling, the possibility of skewing of the reflective marker capture ability and ankle angle ROM data still remained. Lastly, the subjects were asked to perform the side shuffle without shoes. Further analysis is suggested in performing future studies.

CONCLUSION: This study found no significant indicators of differences in side shuffle performance between conditions. Significant differences between ankle joint ROM were found between trials with and without a brace. Other kinematic and kinetic variables were found to be similar. More studies are needed to completely understand the full effects of ankle stabilizers on medial-lateral performance.

REFERENCES:

Ambegaonkar, J., Redmond, C., Winter, C., Cortes, N., Ambegaonkar, S., Thompson, B., & Guyer, S. M. (2011). Ankle stabilizers affect agility but not vertical jump or dynamic balance performance. *Foot Ankle Specialist*, *4*(6), 354-360.

Backx, F. J. G., Beijer, H. J. M., Bol, E., & Erich, W. B. M. (1991). Injuries in high-risk persons and high-risk sports: A longitudinal study of 1818 school children. *American Journal of Sports Medicine, 19*(2), 124-130.

Bot, S.D., & van Mechelen, W. (1999). The effect of ankle bracing on athletic performance. *Sports Medicine, 27*, 171-178.

Cloak, R., Galloway, S., & Wyon, M. (2010). The effect of ankle bracing on peak mediolateral ground reaction force during cutting maneuvers in collegiate male basketball players. *Journal of Strength and Conditioning Research/National Strength and Conditioning Association*, *24*(9), 2429-33.

Eils, E., & Rosenbaum, D. (2001). A multi-station proprioceptive exercise program in patients with ankle instability. *Medicine and Science in Sports and Exercise, 33*(12), 1991-1998.

Gardner, J. , McCaw, S. , Laudner, K. , Smith, P. , & Stafford, L. (2012). Effect of ankle braces on lower extremity joint energetics in single-leg landings. *Medicine and Science in Sports and Exercise*, *44*(6), 1116-1122.

Garrick, J. G., & Requa, R. K. (1973). Role of external support in the prevention of ankle sprains. *Medicine and Science in Sports and Exercise, 5*(3), 200-203.

Garrick, J. G., & Requa, R. K. (1988). The epidemiology of foot and ankle injuries in sports. *Clinics in Sports Medicine, 7*(1), 29-36.

Greene, T.A., & Hillman S.K. (1990). Comparison of support provided by a semi-rigid orthosis and adhesive ankle taping before, during and after exercise. *American Journal of Sports Medicine, 18,* 498–506.

Gross, M.T., Bradshaw, M.K., Ventry, L.C., & Weller, K.H. (1987) Comparison of support provided by ankle taping and semirigid orthosis. *Journal of Orthopaedic & Sports Physical Therapy, 9,* 33–39

Gross, M., Clemence, L., Cox, B., McMillan, H., Meadows, A., Piland, C., & Powers, W. (1997). Effect of ankle orthoses on functional performance for individuals with recurrent lateral ankle sprains. *Journal of Orthopaedic and Sports Physical Therapy*, *25*(4), 245-252.

Gudibanda, A., & Wang, Y. (2007). Effect of the ankle stabilizing orthosis on foot and ankle kinematics during cutting maneuvers. *Research in Sports Medicine: An International Journal*, 111-126.

Ivins, D. (2006). Acute ankle sprain: An update. *American Family Physician, 74*(10), 1714-1720.

Jackson, K.M. (1979). Fitting of mathematical functions to biomechanical data. *IEEE Transactions on Bio-Medical Engineering*, 26(2), 122-124.

Lardenoye, S., Theunissen, E., Cleffken, B., Brink, P., de Bie, R., & Poeze, M. (2012). The effect of taping versus semi-rigid bracing on patient outcome and satisfaction in ankle sprains: A prospective, randomized controlled trial. *BMC Musculoskeletal Disorders*, (13), 81-88.

Lundbrook, J. (1998). Multiple comparison procedures updated. *Clinical and Experimental Pharmacology and Physiology*, *25*, 1032-1037.

Rosenbaum, D., Kamps, N., Bosch, K., Thorwesten, L., Volker, K., & Eils, E. (2005). The influence of external ankle braces on subjective and objective parameters of performance in a sports-related agility course. *Knee Surgery, Sports Traumatology, Arthroscopy*, *13*, 419-425.

Newman, T., Croy, T., Hart, J., & Saliba, S. (2012). The effects of prophylactic ankle bracing on dynamic reach distance and obstacle course performance in military cadets. *Military Medicine*, *177*(5), 567-572.

Nishikawa, T., Kurosaka, M., Mizuno, K., & Grabiner, M. (2000). Protection and performance effects of ankle bracing. *International Orthopedics*, *24*(5), 285-288.

Osborne, M. D., & Rizzo, T. D. (2003). Prevention and treatment of ankle sprain in athletes. *Sports Medicine, 33*(15), 1145-1150.

Papadopoulos, E. S., Nicolopoulos, C., Anderson, E. G., Curran, M., & Athanasopoulos, S. (2005). The role of ankle bracing in injury prevention, athletic performance and neuromuscular control: A review of the literature. *The Foot, 15*(1), 1-6.

Pienkowski, D., McMorrow, M., Shapiro, R., Caborn, D.N.M., & Stayton, J. (1995). The effect of ankle stabilizers on athletic performance: A randomized prospective study. *American Journal of Sports Medicine, 23*(6), 757-762.

Rosenbaum, D., Kamps, N., Bosch, K., Thorwesten, L., Völker, K., & Eils, E. (2005). The influence of external ankle braces on subjective and objective parameters of performance in a sports-related agility course. *Knee Surgery, Sports Traumatology, Arthoroscopy, 13*(5), 419-425.

Wright, I.C., Neptune, R.R., van den Bogert, A.J. & Nigg B.M. (2000) The influence of foot positioning on ankle sprains. *Journal of Biomechanics,* 33, 513-519.

Yeung, M. S., Chan, K. M., So, C. H., & Yuan, W. Y. (1994). An epidemiological survey on ankle sprain. *British Journal of Sports Medicine, 28,* 112-116.