COULD PLAYING SURFACE INFLUENCES CHANGE OF DIRECTION AND PERCEIVED TRACTION PERFORMANCE IN FUTSAL?

Shariman Ismadi Ismail[1,3], Hiroyuki Nunome[2] , Yuji Tamura[2] and Shusei Sugi[3]

Faculty of Sports Science and Recreation, Universiti Teknologi MARA, Shah Alam, Malaysia[1]
Faculty of Sports and Health Science, Fukuoka University, Fukuoka, Japan[2]
Graduate School of Sports and Health Science, Fukuoka University, Fukuoka, Japan[3]

The purpose of this study was to identify differences on change of direction performance, perceived traction performance and available friction coefficient between two different futsal playing surfaces. Functional test and perceived traction evaluation were performed by twenty experienced male university level soccer players using slalom course on two different playing surfaces (area-elastic:AE and point-elastic:PE). Available friction coefficient (AFC) for each playing surface was mechanically measured using a hydraulic-powered moving force platform. In the functional test, participants were found to perform significantly better on PE when compared to AE surface ($p<0.001$). PE surface was also found to have higher perceived traction performance ($p<0.001$). It was suggested that significantly higher AFC observed on the PE surface compared with AE surface ($p<0.001$) may contribute to the observed findings. This study succeeded in demonstrating the performance of change of direction run was significantly influenced by the playing surface traction and frictional properties.

KEYWORDS: futsal, change of direction, playing surfaces, friction coefficient.

INTRODUCTION: Indoor soccer, commonly known as futsal, is one of the fastest-growing indoor sports in the world (Berdejo-del-Fresno, 2014; Moore & Radford, 2014). Like any other sports, the playing surface is crucial for injury prevention and successful performance. In 2019, the first futsal technical standard was released by the Fédération Internationale de Football Association (FIFA). The standard includes requirement for futsal playing surface. Currently, there are no specific standard for types of playing surface for futsal. Thus, it is very common for the game being played on several type of surfaces, namely wooden flooring [area-elastic (AE)] or on various types of synthetic surfaces [point-elastic surface (PE)]. To date, it is still inconclusive how different types of playing surfaces commonly used in futsal influenced the players playing performance.

Footwear–playing surface interaction in futsal could potentially be explained by the playing surface technical specification such as the shock-absorption level and vertical deformation (Dixon et al., 2015). While higher shock-absorption level and vertical deformation commonly provided by AE playing surfaces would offer better protection and comfort to the players, it is still unknown whether these aspects of surfaces have substantial impact on player’s performance.

Therefore, both sports-specific functional test and the player perceived performance to the playing surfaces could potentially be used as an indicator to illustrate the influence of playing surface on player’s performance. In addition, it is widely accepted that playing surface frictional properties is important for athletic performance (McGhie & Ettema, 2013; Worobets & Wannop, 2015). However, it is still unclear whether there are any differences between AE and PE playing surfaces for their available friction coefficient properties. The purpose of this study was to identify the effect of different types of futsal playing surface on: (1) change of direction performance, (2) perceived traction performance, and (3) available friction coefficient. It was hypothesized that there are significant differences across all three parameters mentioned above between AE and PE playing surfaces.

METHODS: In this study, twenty experienced male university level soccer players were recruited (Age 20.3 ± 1.3 years old, body mass 68.8 ± 4.4 kg, height 175 ± 4 cm, soccer experience 13.3 ± 2.3 years). All participants are active in university level competition and have involved in competitive level for more than 10 years. The exclusion criteria include history of lower limb fracture and ligament injury.

The experimental set-up of the change of direction functional test (slalom course) is shown in Figure 1a. Two identical test area were prepared separately for two types of playing surfaces (AE: hardwood surface, PE: vinyl surface). These technical specifications based on the manufacturers technical data are as follows: (1) Shock-absorption; AE: 40–55%, PE: 25–35%, (2) Vertical deformation; AE: 1.8–3.5mm, PE: <2.0mm, (3) Sliding coefficient; AE: 80–110, PE: 80–110. An infrared timing-gate system (Witty System, Microgate, Italy) was utilized to record the resultant running time of this test. All participants wore the same futsal shoes although differing in size during the test. Each participant performed three maximal trials in a randomized order on each futsal playing surface. All participants were also requested to evaluate their perceived shoe–playing surface traction performance immediately after each trial using 5-point Likert scale (1 = poor, 2 = fair, 3= average, 4 = good, 5 = excellent).

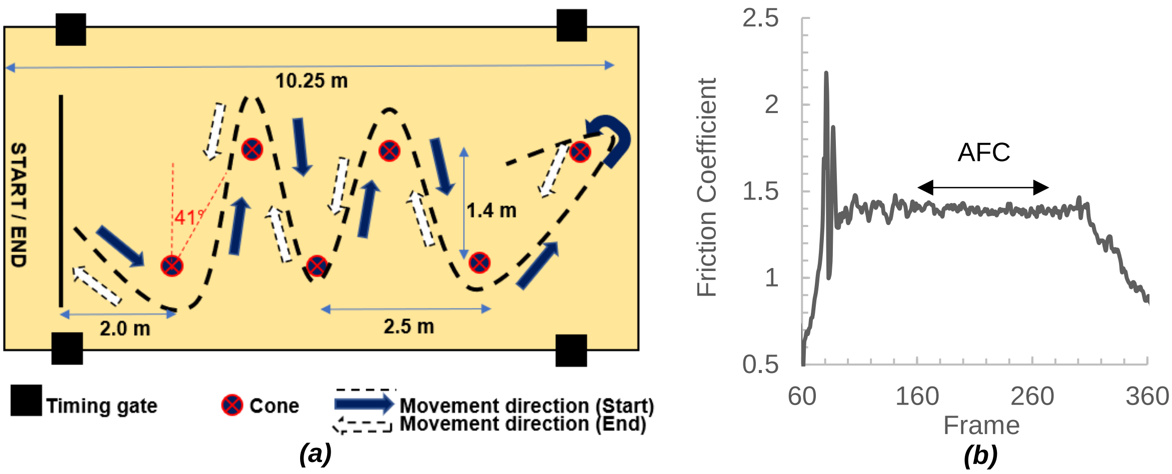

Figure 1: (a) Slalom course (b) Example of a typical friction coefficient curve

Available friction coefficient (AFC) for each playing surface was measured using a mechanical system consisting a 4-degrees of freedom, hydraulic-powered moving force platform set at 1200 Hz. Above the platform, an artificial foot made from nylon was statically secured to a profile steel frame structure. During mechanical test, the same model of futsal shoe that was used by participants in the functional test was secured to the artificial foot. Samples of playing surface was attached on top of the force platform and secured by a strong double-side tape. To avoid any unwanted movement, the shoe and the artificial foot was also strongly secured at the anterior and posterior of the shoe using bolts and nuts. The moving force platform was controlled using a customized system (Mr. Kick, v. 2.030, Knud Larsen, Aalborg University, Denmark). The platform starts at an initial position below the shoe and upon activation, it will move towards the static shoe to receive the normal load that are applied to the shoe. Upon receiving the normal load, the force platform with move horizontally, creating a backward horizontal sliding motion between the top layer of the playing surface and the shoe outsole. The test condition was set as the followings: (1) Normal load = 500N, (2) Force platform sliding velocity at 1.0 m/s, (3) Shoe and playing surface sliding horizontally with contact angle at 0 degree. Each playing surface was test for five times. The ground reaction forces (Fx, Fy,Fz) during the mechanical test were recorded using Qualisys motion analysis system (Qualisys AB, Gothenburg, Sweden) and analysed using Visual 3D v6 (C-Motion Inc., Maryland, USA). The friction coefficient was calculated using the following equation:

$$Friction\ coefficient, FC = \frac{\sqrt{Fx^2 + Fy^2}}{|Fz|}$$

The AFC was defined as the mean value of friction coefficient during 100 ms of the steady-state condition of the friction coefficient curve as shown in Figure 1b (Morio et al., 2015).
All statistical analyses in this study were conducted using independent-sample t-test (PSPP software version 1.0.1) at p <0.05 significance level. The effect size was measured using Cohen's d (Cohen, 1988).

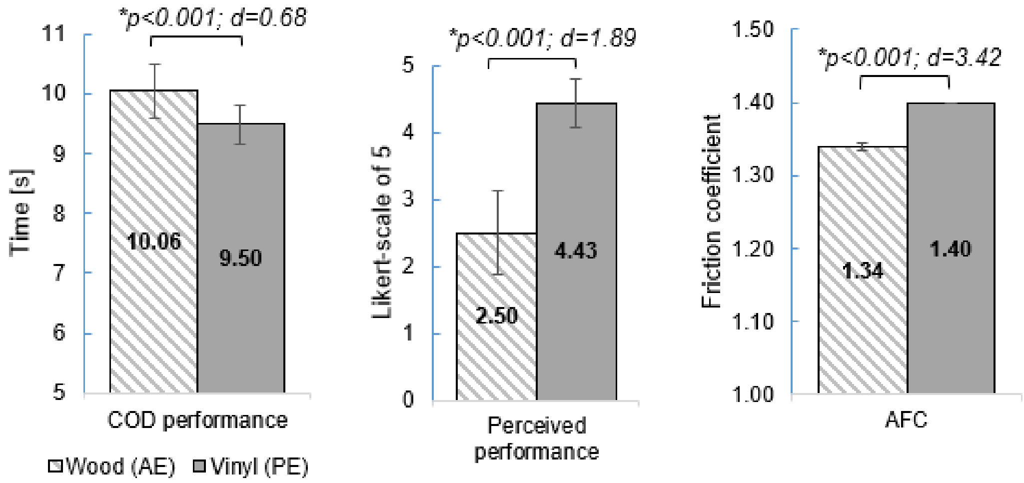

Figure 2: Mean value (±SD) of (a) change of direction performance, (b) perceived traction performance and (c) available friction coefficient (*t-test: p<0.05). Effect sizes are shown as Cohen's d.

RESULTS: The results obtained from this study are presented in Figure 2. Significantly better performance by participants were observed when performing the functional test on AE surface compared to the PE surface (p<0.001; Cohen'd=0.68, Figure 2a). Similarly, participant's perceived traction performce on PE surface was significantly higher than that of AE surface during the functional test (p<0.001; Cohen's d=1.89, Figure 2b). These outcomes could be partially explained by the significantly higher available friction coefficient between shoe and PE surface when compared to AE surface (p<0.001; Cohen's d =3.42, Figure 2c).

DISCUSSION: Interestingly, contradicting result has been reported for the differences between PE and AE playing surface during an agility test protocol (Serrano et al., 2019). They reported that participants performed better on AE playing surface when compared to PE playing surface. Difference in test protocols and participant's age-groups might partially explain these contraducting results, however, the fact that the previous study did not measure frictional properties for tested surfaces should be emphasezed as a point warrants investiagting. Therefore, it is unknown whether the AE playing surface used in the study possessed relatively higher available friction coefficient or not. The contradicting findings suggests that frictional specification of playing surface could be crucial and should be clearly highlighted in the product or material specification.
Currently, most manufacturer only reported the playing surface friction; specification using the sliding coefficients value range, typically between 80–110 in accordance to the EN ISO standard. However, as describe in this study, this specification is not sensitive enough to discriminate the available friction coefficient between two different playing surfaces. This study also highlighted the shock absorption and vertical deformation aspects of playing surface were a less dominant factor to the available friction coefficient aspect. PE surface tested in this study possessed relatively lower shock absorption and vertical deformation properties when compared to AE surface, yet its available friction coefficient was significantly superior.
Finally, sport-specific functional test like the one used in this study did represent traction-related aspects between futsal footwear and playing surfaces, thereby supporting then findings

of other previous studies with similar interest on playing surfaces (De Clercq et al., 2014; McGhie and Ettema, 2013). This finding emphasizes the feasibility of functional tests with multiple changes of direction to evaluate shoe-playing surface interactions, rather than a functional test with only one direction of motion such as straight-line sprint test (Sterzing et al., 2009).

CONCLUSION: In this study, we succeeded in demonstrating significant influence of futsal playing surfaces on change of direction, perceived traction performance and friction coefficient. Point-elastic surface used in this study was found to be favourable across all three parameters measured when compared to area-elastic surface. It was concluded that higher available friction coefficient possessed by the point-elastic surface may influence the change of direction and perceived traction performance of the participants. Moreover, it was also identified that playing surface with higher shock absorption and surface vertical deformation specifications do not improve futsal players performance, especially related to change of direction performance.

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