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Analysis of the ball speed in the kick of futsal players as a function of the contact instep of the lower limbs

Análise da velocidade da bola no chute dos jogadores de futsal em função da face de contato dos membros inferiores

Análisis de la velocidad del balón en el golpeo de jugadores de fútbol sala en función del empeine de contacto de los miembros inferiores

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Ben Hur Soares
ORCID: https://orcid.org/0000-0001-6762-4799
University of Passo Fundo, Brazil
E-mail: benhur@upf.br
Denis Junior Vicensi
ORCID: https://orcid.org/0000-0002-7405-7101
University of Passo Fundo, Brazil
E-mail: denis.vicensi99@gmail.com
Mylena Aparecida Rodrigues Alves
ORCID: https://orcid.org/0000-0001-8614-407X
Federal University of Paraná, Brazil
E-mail: mylena_cg@hotmail.com
Marcial Adan Manzanares Ballesteros
ORCID: https://orcid.org/0000-0002-7201-0772
University of Passo Fundo, Brazil
E-mail: mbmanzanares77@gmail.com
Sergio Adriano Gomes
ORCID: https://orcid.org/0000-0003-1989-852X
Catholic University of Brasilia, Brazil
E-mail: congressfutsal@gmail.com
Carlos Ernesto Santos Ferreira
ORCID: https://orcid.org/0000-0003-2397-5866
Catholic University of Brasilia, Brazil
E-mail: ernestobsb@gmail.com
Rudy Jose Nodari Junior
ORCID: https://orcid.org/0000-0002-8375-657X
Salus Dermatoglifia, INOVALE, Brazil
E-mail: rudy.nodarijunior@salusdermatoglifia.com.br
Adriano Paqualotti
ORCID: https://orcid.org/0000-0001-7544-9425
University of Passo Fundo, Brazil
E-mail: pasqualotti@upf.br
Rogerio da Cunha Voser
ORCID: https://orcid.org/0000-0001-5946-6989
Federal University of Rio Grande do Sul
E-mail: rogerio.voser@ufrgs.br

Abstract
In order to identify the variation of the ball speed in kicks performed with different contact faces in futsal, 30 athletes were evaluated, who performed three kicks with the inside face, back and toe, of the 10-meter shot, separating the dominant and non-dominant sides. A BUSHNELL speed radar, model 101911, measuring in km/h was used. Statistical tests were performed and the results showed statistical differences in toe and instep kicks, with velocity greater than the inner instep in both dominant and non-dominant. These findings help in training planning, with the aim of increasing the effectiveness of this motor action.
Keywords: Futsal; Kick; Ball speed; Instep kick.

Resumo
Com o objetivo, de identificar a variação da velocidade da bola em chutes realizados com diferentes faces de contato no futsal, foram avaliados 30 atletas, que efetuaram três chutes com cada face do pé, do tiro de 10 metros, com a face interna, dorso e bico do pé, separando o lado dominante e não dominante. Utilizou-se um radar de velocidade

BUSHNELL, modelo 101911, medindo em Km/h. Foi realizado testes estatísticos e os resultados apresentaram diferenças estatísticas nos chutes com o bico e dorso do pé, com velocidade maior que a face interna tanto no dominante e no não dominante. Esses achados auxiliam o planejamento do treinamento, com o objetivo de aumentar a eficácia nessa ação motora.
Palavras-chave: Futsal; Chute; Velocidade da bola; Faces do pé.

Resumen
Con el fin de identificar la variación de la velocidad del balón en los tiros realizados con diferentes caras de contacto en el fútbol sala, se evaluaron 30 atletas, quienes ejecutaron tres tiros con la cara interior, atrás y punta, del tiro de 10 metros, separando el dominante y el no. -lados dominantes. Se utilizó un radar de velocidad BUSHNELL, modelo 101911, que mide en km/h. Se realizaron pruebas estadísticas y los resultados mostraron diferencias estadísticas en las patadas con los dedos y con el empeine, con una velocidad superior a la del empeine interno tanto en dominante como en no dominante. Estos hallazgos ayudan en la planificación del entrenamiento, con el objetivo de aumentar la eficacia de esta acción motriz.
Palabras clave: Fútbol Sala; Patear; Velocidad de la bolón; Empeine de los pies.

1. Introduction

Futsal is a team sport organized and regulated by the International Football Federation - FIFA (FIFA, 2020). According to the entity, there are approximately 30 million practitioners at different levels of this modality (Agras et al., 2016).

Like other modalities of invasion, futsal has characterized by a dispute between two teams that face each other on a playing court, where players interact through individual and collective actions, with the purpose of scoring goals and preventing opponents achieve the same objective (Gréhaigne et al., 2010).

Among the main technical foundations of futsal, Apolo (2007), Lucena (2008) and Voser (2019), cite the pass, domain, reception, driving, dribbling, dribbling, kicking and marking, as being basic for the practice of sport. There are required at different times of the game, demanding from the player the improvement of these components. The foundation of the kick receives a special emphasis, executed by the individual's lower limbs, being the best and most used way to reach the opponent's goal and the assignment of goals (Amadio & Serrão, 2004).

For Lucena (2008), the kick is the action of striking the ball, deflecting or giving it a trajectory, stopped or in motion. Costa Junior and Souza (2005), emphasizes the coordination between the support foot close to the ball, the lever foot, which will touch the ball, balance, strength, precision, intention and objective, are aspects to be observed in training for its improvement.

From this perspective, for an individual to perform the execution of a kick as close to perfection as possible, he needs to have continuous motor learning and begin to develop and train a skill to learn and not unlearn more. Another relevant factor is the maximum force kick and the behavior of the ball speed had totally related to the athlete developing mastery over the technique in front of the dominant (LD) and non-dominant limb (LND), this could lead to a difference in foot speed and collision mechanics within ball (Benda, 2006).

This foundation presents joint movements resulting in a final coordinating action of the salonists' lower limbs, with the purpose of increasing strength, speed and precision on the ball (Sá et al., 2021), being relative to each situation offered and needed in the game, thus being a variable phenomenon (Ishii et al., 2009).

Researchers, have concluded that segmental velocities movements, are close to distal, and that there is a lower velocity in the backward swing of the leg when flexed knee, reaching its peak of velocity in the advance of the leg and knee extension (Dorge et al., 1999; Nunome et al., 2002).

The kick has a succession of very complex movements, the result of joint harmony of the trunk and lower limbs, requiring different phases and varied movements that are articulated and favor precision and power (Moreira, 2008). Furthermore, Dörge et al. (2002) pointed out that the behavior of the ball velocity after a maximum force kick has related to

the mastery of its technique LD and LND, and that it can be, directly affected by the speed of contact with the ball, as well as collision mechanics.

This preference determination is defined by the individual of according to their role in performing tasks (Gobbi et al., 2001). In practice, to equate the tactical-technical tasks, salonists mobilize the right and left hemispheres in the sagittal plane of the lower limbs. From this perspective, the member most used to kick the ball, with the purpose of enabling the tactical principles of attack.

For people with dominance in the right hemisphere (right-handed), the stabilization support of the body has evidenced in the LND, while in people with dominance in the left hemisphere (left-handed) this occurs in reverse. It has noticed that this laterality is a variable that influences the kick when performed with the LND, where the approach run, the positioning of the support foot and the speed of the kick have impacted by it, being interesting that it develops similar performance between homologous members (Barbieri, et al., 2008).

In view of the above, the present study aimed to evaluate and compare the speed of the ball in the kick of futsal athletes according to the contact face between the dominant (LD) and non-dominant (LND) hemispheres in the sagittal plane.

2. Methodology

The present investigation has characterized as a cross-sectional, quantitative field study, where 30 athletes from clubs who competed in the competitions of the Gaúcha de Futsal League - LGF, season 2021, male suit, adult category was analyzed.

The participating athletes have informed of the evaluation procedure and signed a Free and Informed Consent Term - TCLE, according to Resolution 466/2012 of the National Health Council and the Declaration of Helsinki. This research were approved by the Ethics Committee for Research on Human Beings, from Fundação Universidade de Passo Fundo, in accordance with the ethical standards of norms and regulatory guidelines for research involving human beings, under Opinion No. 5,020,129.

Procedures

For the execution of the kick, it had used as a protocol. The performance of three kicks with each of the sides of the foot (inside, dorsum and toe), all kicks were performed on the mark of ten meters between the ball and the goal, in a futsal court as recommended by the rules of this modality (FIFA, 2020). Penalty brand balls had used, according to LGF 2021). To measure the ball speed of the kick technical foundation, the sequence defined by lot had followed, namely: the first kick had performed with the dorsum of the foot, the second with the inner face and finally the beak kick.

Data had collected and completed on site during the night training period carried out by the team, with a pre-scheduled time. Before performing the test, a standardized warm-up lasting 10 min had performed, with basic movements of displacement, technical actions and stretching with emphasis on the lower limbs. Behind the predetermined goal, the evaluator had placed on, holding a BUSHNELL radar, model 101911, with measurement in Km/h.

After performing each of the kicks, the recorded speed was recorded in a specific worksheet, containing the athlete's identifier, face of the foot used, laterality (LD and LND), after which the radar was reset for the next collection. In order to avoid wear out and direct interference in the speed of the kick, the collections had carried out, in order of drawing where when executing one of the attempts; it passed to the end of the list. Thus providing a rest time between a finalization and another until completing its series of that instep kick of contact and dominance. Being first collected the velocities of one face of the foot and dominance, and then moving to the other face, after the three attempts, the contact face was changed and at the end of in all three, the dominance of the performing member had altered. At the end of the collections, the indicative of the highest

speed kick delivered by each of the literalities on their respective contact faces had selected.

We emphasize that because we are still in the midst of the COVID-19 pandemic, the appropriate care measures had taken, through the preventive protocols stipulated for the moment, in relation to the pandemic. After the three attempts, the contact face had changed and at the end of in all three dominance of the performing member had altered, at the end of the collections, the indicative of the highest speed kick delivered by each of the literalities on their respective contact faces had selected.

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Data analysis

A one-way analysis of variance (ANOVA-One-Way) had performed in order to assess whether there were differences in ball speed between different contact faces. Normality had assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. The assumption of homogeneity of variance had evaluated using Levene's test. Post-hoc analyzes for interaction effects (side*style) were performed using the Bonferroni test. Bootstrapping procedures had performed (1000 re-samplings; 95% CI BCa) to obtain greater reliability of the results, to correct deviations from normality of the sample distribution and to present a 95% confidence interval for the differences between the means (Haukoos and Lewis, 2005). The collected data had considered using the IBM SPSS Statistics software (version 24).

3. Results

Dominant side (LD)

Normality distribution tests showed that the ball velocity variable was not normally distributed (Kolmogorov-Smirnov = 0.103, $p < 0.05$; Shapiro-Wilk = 0.967, $p < 0.05$). The Levene test showed that the groups presented homogeneity of variance (Levene (2.84) = 1.585, $p>0.05$).

The ANOVA results showed that there were differences between the groups [$F(2) = 14.441, p< 0.000$]. Games-Howell's post-hoc test, interpreted through bootstrapping procedures, showed that significant differences had found between the Inner Face and the Back and between the Inner Face and the Back. However, the kick with the beak showed no significant difference with the kick with the dorsum of the foot [($\Delta M = 0.80$, IC 95% Bca (-4.21 – 6.16)]) (Table 1).

Table 1 - Demonstration of the average and standard deviation, of the speed of the ball after the kick, in the LD and LND, general average and their respective differences.

	LD Km/h	LND Km/h	p-value
Internal face	82,30±7,7†#	74,10±7,35†#	<0,05*
Nozzle	92,72±7,5†	83,04±6,52†	<0,05*
Back	91,92±9,3#	82,04±8,4#	<0,05*
General Average	88,98±9,4	79,73±8,43	

† There was a significant difference between the inner face and the beak ($p<0.05$)
# there was a significant difference between the inner face and the back ($p<0.05$)
Source: Authors.

Non-dominant side (NDL)

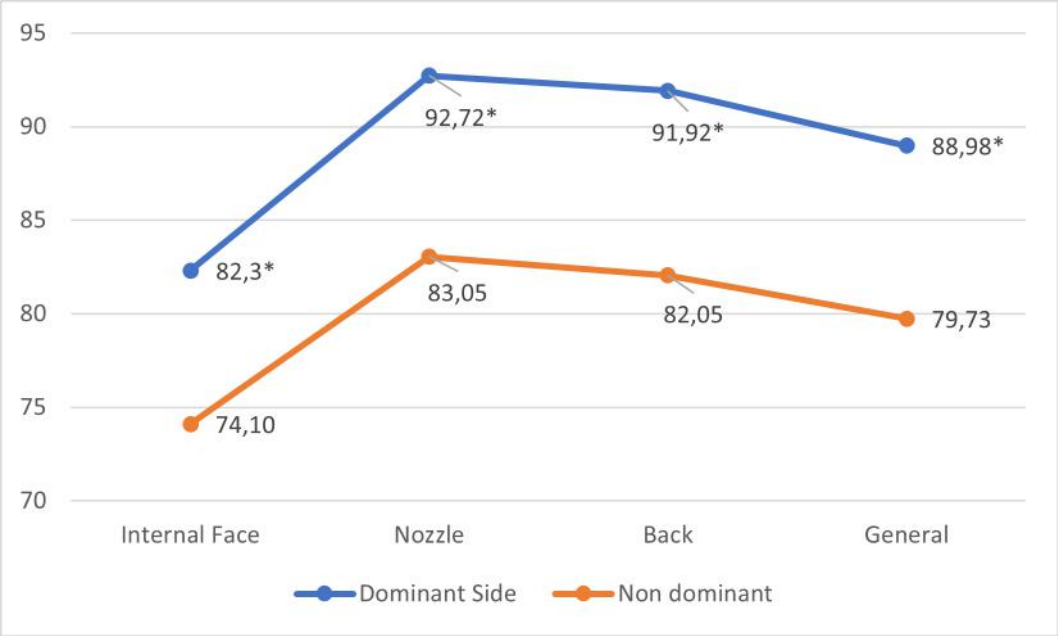
In the LND, its tests distribution ball velocity, variable was normally distributed (Kolmogorov-Smirnov = 0.054, $p > 0.05$; Shapiro-Wilk = 0.982, $p > 0.05$). Levene's test showed homogeneity of variance (Levene (2, 84) = 1.413, $p > 0.05$)

(Table 1).

The ANOVA results were differences between the groups [F(2) = 12.390,p< 0.000]. Games-Howell's post-hoc test, interpreted through bootstrapping procedures, showed that significant differences had found between the Inner Face and the Beak and between the Inner Face and the Back. However, again, the kick with the beak showed no significant difference with the kick with the dorsum of the foot [(ΔM = 0.99, 95% CI (-3.79 - 5.79)].

Figure 1 shows a difference, 11.06%* higher in the speed of the LD kick with the inner face of the foot, and this same side also presented a higher speed in the kicks with the Beak (11.65%*) and Back (12.03%*), and in general the speed for the LD was 11.60%*.

Figure 1 - Demonstration of the average speed of the ball in Km/h, on the different sides of the foot, between the LD and LND.



Source: Authors.

When comparing the ball velocities between the contact faces with the LD with the LND, the normality distribution tests showed that the ball velocity variable presented a normal distribution (Kolmogorov-Smirnov = 0.055, p > 0.05; Shapiro-Wilk = 0.990, p > 0.05) and the Levene test the groups, showed homogeneity of variance (Levene (5, 168) = 1.457, p > 0.05).

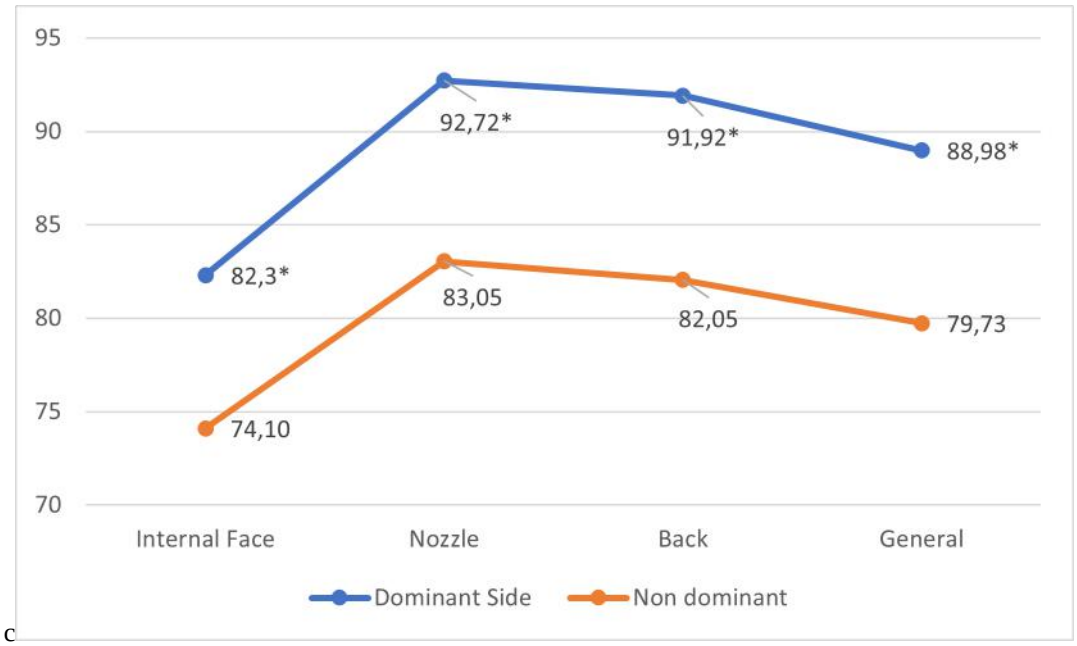
The ANOVA results showed that there was a statistically significant effect for the kicking side (F (1.168) = 60.135, p < 0.001, η^2 = 0,264) and for the kicking style (F(2) , 168) = 26.822, p < 0.001, η^2 = 0.242), however, in turn. It showed that there was no statistically significant effect for the interaction between side (LD and LND) and style (inner face, beak and back) (F(2, 168) = 24.444, p = 0.821, η^2 = 0.002).

To better understand these findings, subsequent analyzes were performed (Bonfenrroni post-hoc) (Figure 2). The results showed that the Toe and Back kick presented significantly higher speed than the Inner Face kick. The Inner Face kick presented statistically lower velocity than the Toe and Dorsum, thou, the LD presented significantly higher speed than the LND.

Regarding the interaction (side*style), the LD showed significantly higher speed than the LND in all comparisons. However, only the comparison between the kick of Toe with the kick of Dorsum that there was no significant difference when

they were evaluated for the same side.

Figure 2 – Demonstration of the interaction between kicking style and kicking side.



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Source: Authors.

4. Discussion

With the objective of comparing the speed of the ball in the kick according to the contact face between the LD and LND in futsal, the problematic perspective of the present study addresses a theme that intertwines the technical capacity of the contact face of the foot when executing a shot, crossing with the speed acquired in it.

Studies already referenced, portray the concern with the asymmetry between LD and LND in the execution of the kick in futsal, a fact that could increase the technical quality of such a foundation (Carey et al., 2001).

The qualification and improvement bias in this aspect, ennobles the practitioner, as it allows him to increase his ability to finish and at the same time make it difficult to mark the opponent. It is clear that the LD ends up being the most used both in training, as well as in finishing in games, and that the kicks performed with the LD presented better performance and greater ball speeds (Barbieri, 2008).

This fact is associated with the practitioner's safety in using the LD, for having a more accurate technique in performing the different fundamentals of the modality, which is due to the greater number of stimuli given and used by the athlete in the training sessions.

When analyzing students from basic to adult categories, Endres et al. (2003) found an increase in ball speed over the years. However, the author detected a final mean speed in the adult category of 96.6 ± 5.1 km/h, regardless of the face of the foot used, which is higher than the findings in the present study.

On the other hand, Zanatta et al. (2020), when evaluating girls in the futsal base category, found differences in the speed of the kick, as the age group advanced, being lower than the findings in the male suit, a fact that may be directly linked to the hormonal and genetic aspects involved. These data show that, regardless of the sex of the futsal player, there is an increase in the speed of the ball in shots on goal. However, a greater speed had observed in the adult category, where maturation is complete and the motor repertoire is greater when had compared to the initiation and training process in the basic categories.

However, studies by Teixeira et al. (2003) and Barbieri et al. (2006), corroborate the findings of the present study, portraying indices of better performance in the execution of the kick when using the LD.

Soares et al. (2021) found differences in kick speed when comparing futsal students and practitioners, determining that there is asymmetry between limbs, and the higher speed found in school participants is directly linked to the technical aspect of training. where greater use is emphasized, of the LD, as well as the greater speed in the finishes, evidencing that participants of schools, having a greater stimulus to the modality and to the specific exercises. These asymmetries, in addition to reducing the athlete's finishing power, also reveal a mismatch in the muscular structure, as one- side ends up a lot more used so far, where it can increase the risk of injury as portrayed by França and Babilônia (2018).

When we analyzed the contact faces with the ball, Soares et al. (2001), evaluated the use of these in submissions to the opposing goal, detected a prevalence of the use of the dorsum of the foot (64.46%), followed by the beak (22.3%) and the internal surface of the foot (12.89%). Demonstrating that high-level athletes prioritize the use of faces that increase the speed of the ball on this basis. These findings corroborate the results of the present study, where the speed detected on the back and beak faces had characterized by being of higher speed compared to the inner face of the foot.

On the other hand, Bongiorno and Soares (2004) analyzed the execution of the technical foundation pass in futsal, and found a prevalence of the use of the inner surface of the foot with 79.94% demonstrating that it a contact face that raises the technical quality in detriment to speed, when compared with the dorsum and toe faces.

5.Conclusion

The findings of the present study demonstrate the existence of different ball speeds when different contact faces had used when performing the technical foundation of the kick, significantly differentiating a more technical kick from a higher speed kick.

Another elucidated fact is the existence of an asymmetry between the LD and LND in relation to the speed of the ball in this technical foundation.

Thus, we suggest training sessions, regardless of the age of the practitioner, include technical activities that require bilateral mobilization of the lower limbs in the practice of different technical fundamentals, especially the kick. We encourage the scientific community to develop new studies like the present one focused on the female public and on the basic categories of futsal.

Limitations

We emphasize that in the present study, due to the restrictions generated by the COVID 19 pandemic, we had a limited number of individuals who had selected to compose the sample. Another limitation that deserves been highlighted is the time used to make the collections, which sometimes generated an excessive use of time in the training session.

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