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DIFFERENCES IN THE MAXIMUM SHOT SPEED OF HANDBALL PLAYERS IN RELATION TO THE RESIN USED

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SUMMARY

A player's ability to execute powerful and accurate shots is crucial for success in handball. The role of adhesives has received less scientific scrutiny in regard to its influence on shot speed. This research investigates the influence of adhesive choice on maximum shot speed in handball, focusing on two prominent resin products: Trimona Classic and Select Profcare. Employing a comprehensive analysis of four distinct shot techniques made both from the standing and running start positions, the research goal was to determine whether different resin types significantly contribute to handball players' shot speed. Contrary to initial expectations, the results revealed no statistically significant differences in shot speed between the two tested resin types. Possible explanations include the limited variability in resin compositions between Trimona and Select, the overriding influence of individual player morphological characteristics and skill levels, as well as the potential of handball players to adapt to different resin types. However, certain limitations, such as the narrow focus on two specific resin types and the small subject sample which consisted of only male players warrant caution when making conclusions. This study creates the foundation for future research with the goal of exploring the influence of different adhesive types in regard to playing position, sex, age category and morphological characteristics.

Keywords: handball, adhesives, throwing speed, performance optimisation

INTRODUCTION

The game of handball is characterised by a variety of tactical plays, split-second decision-making and rapid ball movement. A player's ability to execute powerful and accurate shots is crucial for success on the court (Bragazzi et al., 2020; Vila & Ferragut, 2019; Vila et al., 2020; Wagner et al., 2014). While much attention has been given to aspects such as player strength, technique, and tactical prowess, the role of equipment, particularly the adhesive, has received less scientific scrutiny (Raeder et al., 2015).

The adhesives used in handball ensure a secure grip and facilitate the catching of the ball (Zapartidis et al., 2009). Since modern handball is a fast-paced game, the significance of the grip provided by adhesive has an influence on the shot technique, and consequently the shot speed (Karišik et al., 2016). There is a diverse range of adhesive types available in handball. These include resins, commonly referred to as glue or wax, sprays, and even adhesive-free sticky balls.

Resin is the most commonly used adhesive in modern handball (Bracamonte et al. 2021). Handball players apply it to the hand and the ball before and during training and match, without special control over the amount of glue used. The benefits of using resin in handball are manyfold. The resin increases the friction quotient between the hand and the ball. As a consequence, the players have an improved grip on the ball, which allows them to have better ball control and increased confidence when catching, as well as increased accuracy when throwing the ball. The resin is especially important for wingers, who on average have smaller hands than backs and pivots (Karišik et al., 2018). The resin also reduces the amount of hand perspiration, as well as the overall impact of moisture that comes from the ball's contact with players’ sweat during gameplay (Graham, 2023). One additional advantage of using resin is that it reduces forearm fatigue, given that players don’t have to worry about constantly readjusting their grip.

It should be noted that there are certain risks involved with resin use. Because of the wide variety of handball resins in use, some players may experience skin irritation and other dermatological issues depending on the ingredients used. The other risk of resin use is its overuse. As previously stated, players who play in the wing position always want as much of the resin on the ball as possible. This can have an adverse effect on the performance of other players, given that overuse of resin can lead to uncommonly increased friction between the hand and the ball, which in turn reduces pass and shot accuracy, as well as overall attacking performance.

There are many different types of resin that differ in many characteristics. Based on the ingredients, natural and synthetic resin can be differentiated. The other notable characteristics are stickiness, durability, ease of application and removal, as well as cost. In the past decade, more emphasis has been set on the resin’s environmental effect. The importance of environment-friendly materials used in resin is multiple. Given that handball is an indoor sport, it usually shares the training space with other indoor sports. The resin stains on the floor made by bouncing the resin-covered ball are a common occurrence after practice sessions and

games (de la Rubia et al., 2022; Karišik et al., 2018). These stains must be removed in order to ensure a clean, non-sticky surface that won't interfere with other sports activities. The fact that some resin types require specialised resin removal chemical products in order to clean the floor is also important as it further exacerbates maintenance expenses.

The players' health and safety aspect of the resin usage also plays a critical role. It is important that the resin is thoroughly dermatologically tested, ensuring it is safe for use on the skin. Many of the modern resin products are made from hypoallergenic ingredients, which guarantees that they can be used even by players with sensitive skin (Handballsho.com, 2022).

Taking everything into account, it's understandable that there is a broad choice of resins with different combinations of characteristics. However, there exists a notable gap in understanding how different types of resin impact the shot speed in handball. The goal of this research is to compare and explain the distinct differences in maximum shot speeds of handball players using two different types of resin. These findings are relevant both for handball players seeking to optimise their equipment choices and for coaches, equipment manufacturers, and researchers interested in enhancing the overall understanding of the sport.

METHODS

Subject sample

The subject sample consisted of 15 professional handball players who competed in the Serbian Suber B league, which is the second-highest national league flight. The players were male, senior players (age 26 ± 0.9 years, height 179.26 ± 6.82 cm, weight 91.73 ± 10.91 kg), who had been a part of a regular training regime for at least seven years. At the time of testing the players didn't have any significant injuries and weren't taking any medications. This research was approved in advance by the players' respective handball clubs. All experiment procedures, risks and benefits were explained in detail to participants, as well as the coaching and medical staff of their respective clubs. Each player voluntarily provided written informed consent before participating. The research was conducted in accordance with all the ethical standards specified by the Declaration of Helsinki (World Medical Association, 2013).

Variable sample

Two types of resin were used in this research: Trimona Classic (Trimona, n.d.) and Select Profcare (Select Sport, n.d.).

Players performed shots using four different shot techniques, made both from standing still and three-step running start: running jump shot with circular arm swing (ZSSK), running jump shot with direct arm swing (ZSSD), running ground shot with circular arm swing (ZSPK), running ground shot with direct arm swing (ZSPD), standing jump shot with circular arm swing (MSSK), standing jump shot with direct arm swing (MSSD), standing ground shot with circular arm swing (MSPK), standing ground shot with direct arm swing (MSPD).

Procedures

Before the shooting attempts, players were given time to familiarise themselves with both of the resin types used. After the period of adaptation, players were asked to complete a short survey that compares the two resin brands on several characteristics: general feel, stickiness, durability, ease of application and removal. Survey results show that players found that Trimona Classic was pasty, more sticky, more durable, and more difficult to apply and remove than Select Profcare which was in turn described as creamy.

Players were tested in two separate training sessions, with only one resin type used in one session. This was necessary in order to prevent the contamination of the results, given that the removal of one brand of resin and application of another in the same training session produces a feeling of unease in players' fingers and thus may impact the performance.

Before taking the shots, the players were instructed by the experimenter that the goal of the measurement was solely the maximum speed of the shot and that parameters such as precision would not be evaluated. The players directed their shots towards the goal in order to ensure that the situational circumstances were as similar as possible to those they were used to in training sessions and matches. Each shot was performed three times and the best result was recorded. Players were given adequate time to rest between attempts.

In order to measure shooting speed, all shots were recorded using the D5300 camera (Nikon, Japan). The camera was connected to a laptop and its feed was imported in real time to Adobe Premier Pro software (Version 22.2) for video analysis. The video was recorded in 120 frames per second which ensured a high measurement accuracy. The video time was converted to milliseconds. PMML 5 A2 (Parkside, Germany) range finder was used in order to calculate the distance travelled by the ball from the spot where the shot is taken to the goal line. After establishing the time and distance travelled, the software calculated the shot speed in kilometres per hour (km/h).

Statistical analysis

The following descriptive statistic parameters were analysed: mean (Mean), standard deviation (SD), minimal recorded result (Min.), maximal recorded result (Max.), Shapiro-Wilk test statistic (W), Shapiro-Wilk significance level (p). The differences in shot speed between the shots performed with Trimona and Select were calculated with the independent t-test. All statistical analyses were implemented in IBM SPSS Statistics (Version 25).

RESULTS

The descriptive shot speed parameters of different shot techniques based on the resin used are presented in Table 1.

Table 1. *Descriptive parameters of shot speed by resin*

Variable	Resin	N	Mean	SD	Min.	Max.	W	p
ZSSK (km/h)	Trimona	15	93,0 4	4.74	84.23	101.67	.990	.999
	Select	15	92.75	4,6 8	84.17	101.43	.990	.999
ZSSD (km/h)	Trimona	15	82,2 7	4.30	74.98	90.01	.976	.934
	Select	15	82.04	4.3 6	74.71	89.91	.975	.921
ZSPK (km/h)	Trimona	15	78.17	4,5 4	70.40	86.21	.972	.885
	Select	15	78,3 4	4.4 8	70.28	86.20	.982	.980
ZSPD (km/h)	Trimona	15	67.98	4. 10	61.20	75.97	.984	.991
	Select	15	67.86	4. 10	61.19	75.81	.982	.979
MSSK (km/h)	Trimona	15	79.10	4.44	71.13	86.97	.983	.987
	Select	15	78,99	4.36	70.98	86.17	.979	.959
MSSD (km/h)	Trimona	15	52.20	4,0 7	44.98	59.51	.986	.995
	Select	15	52,0 1	4.07	44.47	59.43	.989	.999
MSPK (km/h)	Trimona	15	63.33	4.1 5	55.73	70.94	.982	.979
	Select	15	63,2 5	4.19	55.31	70.84	.986	.994
MSPD (km/h)	Trimona	15	48,6 8	4.1 4	41.67	56.94	.990	.999
	Select	15	48.58	4.09	41.71	56.64	.989	.999

Legend. N: number of participants; Mean: mean; SD: standard deviation; Min.: minimal recorded result; Max.: maximal recorded result; W: Shapiro-Wilk test statistic; p: Shapiro-Wilk significance level.

Due to the small sample size, determining the presumption of the normal distribution of the shot speed data in regard to the resin type used was important in order to choose an appropriate statistical method. Shapiro-Wilk test did not show evidence of non-normal distribution in any of the observed variables. Based on these results, the independent samples t-test could be performed (Table 2).

Table 2. *Independent sample t-test*

	Levenov test		**T-test za nezavisne uzorke**			
Variable	F	str	t	df	p (2-tailed)	MD
ZSSK	.006	.937	0,170	28	.866	0,293
ZSSD	.006	.939	0,143	28	.888	0,225
ZSPK	.016	.900	-0,101	28	.920	-0,166
ZSPD	.003	.957	0,078	28	.938	0,117
MSSK	.003	.955	0,066	28	.948	0,106
MSSD	.001	.979	0,131	28	.897	0,195
MSPK	.004	.949	0,056	28	.955	0,086
MSPD	.002	.965	0,062	28	.951	0,093

Legend. F: Levene's test statistic; p: Levene's test significance level; t: t-test statistic; df: degrees of freedom; p (2-tailed): significance level; MD: mean difference..

Based on the results of Leven's homogeneity of variance test show that the hypothesis of equal variances assumed can be accepted in all variables. The results of the independent sample t-test indicate that there were no statistically significant differences between the two tested resin brands in regard to maximum shot speed in any of the tested variables.

DISCUSSION

The data analysis showed that there were no statistically significant differences in regard to maximum shot speed between Trimona Classic and Select Profcare resins. Even more

interesting are the mean differences, which are almost non-existent, even though the players felt like Trimona Classic was stickier.

The absence of statistically significant differences between the two tested resin types in shot speed across all four distinct shot techniques made from the standing and running starts unveils unexpected insights into the relationship between adhesive choice and handball player performance. Despite the initial hypothesis positing that varying resin properties might influence the shot speed, the findings challenge conventional assumptions and prompt a revaluation of the factors contributing to shot speed in handball.

One plausible explanation for the lack of significant differences could be the limited variability in adhesive characteristics between the two resin types. Trimona and Select, being reputable brands in the handball equipment market, might share similar adhesive compositions or adhere to industry standards that mitigate substantial differences in their impact on players' performance. It should be noted though that the resin still has an important role in the shot speed. In the research conducted by Bracamonte et al. (2021) on the subject sample of 46 players (31 men and 15 women), statistically significant differences ($p < 0.001$) in shot speed between shots performed with and without resin were established.

Furthermore, the intricacies of handball technique and player-specific morphological characteristics might outweigh the influence of resin choice on shot speed. Factors such as skill, strength, and biomechanics could supersede the effects of the adhesive, rendering any distinctions in resin types negligible in the context of shot speed (Chelly, 2010). Such were the findings of Karišik et al. (2016) who established that the length of the arms has the biggest influence on the shot speed in handball. Future research should delve into a more detailed examination of player-specific characteristics to better explain the correlation between individual morphological attributes and resin.

When considering the results of this research, it is also essential to consider the adaptability of handball players to different equipment. Athletes often develop a level of proficiency and familiarity with specific resin, but the experience in using it is transferable and could potentially mitigate the impact of changes of adhesive type.

While the current findings challenge preconceived notions regarding the influence of adhesive choice on shot speed, it is important to acknowledge certain limitations. The study focused solely on two specific resin types, Trimona and Select, and did not encompass the entire spectrum of adhesive options available in the market. Exploring a broader range of adhesives could reveal more nuanced insights into the potential influence of adhesive characteristics on shot performance.

CONCLUSION

In conclusion, the statistically non-significant differences between Trimona and Select resins in regard to shot speed raise intriguing questions about the fine dynamics governing players' performance of attacking actions in handball. This study creates the foundation for future research with the goal of exploring additional factors influencing shot speed. In regard

to the subject of future research in this area, the influence of different adhesive types in regard to playing position, sex, age category and morphological characteristics should be explored. As the pursuit of performance optimization in handball continues, a more profound understanding of the complex set of elements contributing to shot speed remains crucial for handball players, coaches and researchers in the field.

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