Proceeding of International Joint Conference on UNESA
Homepage:https://proceeding.unesa.ac.id/index.php/pijcue
e-ISSN : 3032-376

PIJCU, Vol. 3, No. 1, Agt 2025
Page 144-150

Proceeding of International Joint Conference on UNESA

Petanque Shot Dynamics: Effect of Swing Angle, Speed, and Release Angle at Distances of 6,7,8,9 Meters

Nurkholis[1]
[1*] Universitas Negeri Surabaya, Surabaya, Indonesia

Keywords:
Biomechanics
Shooting
Petanque

ABSTRACT (9 pt)

This study is supposed to analyze the influence of swing angle, movement speed, and release angle on shooting dynamics at 6, 7, 8, and 9 meters in petanque sport. This study used a non-experimental method with quantitative descriptive approach, on 45 male shooting players at PON XXI pre-qualification national championship. Data were collected utilizing Kinovea software and descriptive and inferential statistical test (bivariate correlation). The results revealed that swing angle back, swing speed, and release angle together accounted for most of the shot outcome at all distances. The efficacy of shooting techniques in reducing distance, with maximum contribution at a distance of 7 meters (R Square 0.920) and minimum at a distance of 8 meters (R Square 0.556). The swing speed and back swing angle are optimal at short throws (6 meters), while the release angle is relatively stable at medium throws (6-7 meters). The current study stresses the necessity for adaptive training to develop skills for acquiring back swing, swing speed, and release in order to improve petanque players' performance under varied throwing conditions.

INTRODUCTION

Petanque is a game that requires high accuracy in shooting technique (Asmawi & Lubis, 2020). Biomechanical parameters of swing angle, speed, and release angle of the ball have a major impact on optimal outcomes of shots (Helmi et al., 2024). Interconnected shot mechanics of backswing, swing, release angle, and height of the ball affect the accuracy of a shot (Nurhasan et al., 2024).

Muscle strength and speed of movement research suggests that these two variables have a crucial impact on the success of the shot (Fritch et al., 2021). Speed of movement during the swing phase and the release of the ball at distances of 6 and 7 meters directly correlate with the accuracy of the shot (Phytanza et al., 2022). This confirms the importance of learning biomechanical techniques in a bid to realize stable and maximum outcomes in playing the sport of petanque.

Body balance as well as eye-hand coordination are also important variables in improving the accuracy of petanque shots (Kurniawati et al., 2019). Studies have shown that dynamic balance accounts for as much as 36.74% of shooting accuracy, while eye-hand coordination is another considerable contributor (Pianigiani & Villa, 2022). Players who lack good balance find it difficult to maintain a stable stance when setting up and taking shots (Solihin et al., 2022).

But while several studies have revolved around each aspect of biomechanics separately, little evidence exists that delves into how the combination of swing angle, speed of movement, and the release angle of the ball at a particular distance affects it. The 6 to 9 meter distance marks a critical length for petanque competitions for which different approaches to biomechanics must be adopted for both distances.

This study is aimed at filling this lacuna through an elaborate examination of how angle of swing, movement speed, and release angle impact the dynamics of the shots at distances of 6, 7, 8, and 9 meters. The results of this study will be anticipated to contribute meaningfully towards establishing biomechanics-informed training protocols for improving petanque players' performance

RESEARCH METHOD

This study is non-experimental with quantitative descriptive design. This study describes shooting skill like back swing angle, swing speed, release angle. This study searches and establishes the efficacy of the above factors. Statistical analysis used in this study was descriptive statistics to describe research data, and inferential statistics. Statistical analysis used is bivariate correlation. This research was carried out in the PON XXI Indonesia pre-qualification national championship in the Debes Tabanan Sports Hall, Bali. The population of this research was male shooting sport athletes of the PON XXI prequalification national championship with 45 people (N=45). The research in this study is a population study. Data collection equipment used in this study are kinovea software, video recording cameras that are certified, tripods, laptops, stationery, distance measuring tools (meters), shooting mathematics, iron balls, wooden balls, score boards, score sheets. Test and measurement techniques were used in collecting data for shooting distances of 6, 7, 8, and 9 meters. Descriptive statistics was used in data analysis in this study to describe data of the research.

RESULTS AND DISCUSSION

The results of this study explain related to kinematic data from the movement of shooting petanque which includes revealing the distribution of research sample data, analysis data of shooting throws at distances of 6 meters, 7 meters, 8 meters, 9 meters.

Table 1.

Test data statistics

Distance (m)	R Square
6	.718
7	.920
8	.556
9	.871

The results of the analysis of data revealed that back swing angle, swing speed and release angle variables together explained 71.8% with the result of shooting at a distance of 6 meters and with significance 0.000 < 0.05. Data analysis results showed that the back swing angle, release angle and swing speed variables combined accounted for 92% and explained the shoot results at a distance of 7 meters with a significance level of 0.000 < 0.05. Data analysis findings revealed that the back swing angle variable, swing speed, and release angle variables were related by 55.6% with the results of the shot at 8 meters distance with a significance level of 0.000 < 0.05. The results of data analysis showed that back swing angle variable, swing speed variable and release angle variable collectively were highly correlated by 87.1% with shooting outcomes at 9 meters at a significance level of 0.000 < 0.05.

Table 2.

The distance effectiveness angle was 6,7,8,9 on the back swing, release, and speed swing arm variables.

Variabel	Distance

	6	Average score	7	Average score	8	Average score	9	Average score
Back swing (^{0})	55 - 71	2,5	79 - 94	2,58	88 - 103	1,86	98 - 114	1,7
Release (^{0})	63 - 72	3.0	76 - 84	3.0	89 - 95	2,57	96 - 101	2,2
Speed swing arm (m/s)	2.48-4,48	2,75	4,03-6,02	2,7	4,04 - 6,03	1,7	6,40 - 8,39	1,87

Optimal back swing angle at distance 6 is at 55 - 71, which is with mean 2.5. Through data analysis, optimal back swing angle at distance 7 is at 79 - 94, which is with mean 2.58. Data analysis revealed that optimal back swing angle at distance 8 was at 88 - 103, which was with mean 1.86. Analysis of data indicates that the best back swing angle at a distance of 9 is at 98 - 114, which is with an average of 1.7. Back swings indicate that the effectiveness of this technique decreases with increasing distance. The best score is achieved at a distance of 6, and this indicates that the back swing technique works best at short distances. A decline in scores at distances 8 and 9 indicates that the athletes are able to lose good technique at longer distances.

The efficient swing speed at distance 6 is at 2.48 - 4.48, i.e., with an average of 2.75. It has been proved by the analysis of data that the efficient swing speed at distance 7 was at 4.03 - 6.02, which was with an average of 2.7. Data analysis revealed that the efficient swing speed at distance 8 was at 4.04 - 6.03, which was with an average of 1.7. Data analysis showed that the optimal arm swing speed at distance 9 was at 6.40 - 8.39, which was with a mean of 1.87. The variable speed swing arm had a significant decline in effectiveness at distance 8, with the highest score at distance 6. Such a decline in score may indicate that it is difficult to keep the optimal arm swing speed at distant distances, which affects overall performance.

The best release angle at distance 6 is at 63 - 72, which is with an average of 3.0, Data analysis shows that the effectiveness release angle at distance 7 is at 76 -84, which is with an average of 3.0, Data analysis shows that the effectiveness release angle at distance 8 is at 89 - 95, which is with an average of 2.57. Data analysis showed that effective release angle for the distance 9 was 96 - 101, with a mean of 2.2. For the release variable, effectiveness was maintained at distances 6 and 7 but decreased at distances 8 and 9. It shows that effective release technique can be maintained at shorter distances but is more difficult at longer distances. The decline in scores at distances 8 and 9 indicates that athletes might need to change their technique in order to remain effective.

Figure 1.

Back swing

Figure 2.

Release and speed arm swing

The results of the present study have some important findings regarding the kinematic parameters to influence petanque shooting performance. The result confirms that swing speed, release angle, and backswing angle are all important parameters for excellent shooting at different shooting distances. They obtained maximum R Square among them at 7 meters (0.920), revealing greatest technique application in this distance (Yang, 2018). Yet the performance of these variables degrades with the rise in distance, particularly at 8 and 9 meters, where the players are not capable of maintaining consistent technique. Backswing angle is of foremost significance for short-distance throws but displays a certain degradation of performance in long-distance throws. The highest effectiveness mark for backswing was found at 6 meters (2.5), indicating that this type of style is more effective for shorter throws. This trend explains that players must demand certain training to modify the style of backswing for higher distances, in which it becomes harder to provide accuracy (Mkaouer et al., 2014). Swing velocity also has a trend of reduced performance with raised distance (Schorah et al., 2015). At 6 meters, there was the maximum mean swing speed of 2.75 m/s, in which the significance was highest

concerning accuracy. But with increasing distance, optimal swing speed cannot be maintained, which can hinder the trajectory and accuracy of the throw (Kneblewski et al., 2020). This also points to the need for accurate drills to train consistency in swing speed across distances (Langeveld et al., 2019). The release angle was consistent at closer distances (6 and 7 meters) with a mean rating of 3.0 but dropped sharply at 8 and 9 meters. The decline in performance indicates that even though athletes have excellent release mechanics at near distances, longer throws must be altered, and the majority of athletes are not adept at this. Training must involve flexibility in release angles to maximize performance under different conditions.

The study also implies interdependence of the kinematic parameters. For instance, lower backswing angles necessitate higher swing speed in order to achieve accuracy at longer distances. Higher backswing angles, however, require precise regulation of release angles in order to maintain accuracy (Irawan & Munir, 2021). This interaction highlights the complexity of shooting mechanics in petanque and the necessity of integrative training programs (Alis et al., 2023). Another important finding is the inconsistency in techniques between participants in the studies, particularly in backswing and release angles (Dinda Paulina & Awang Irawan, 2022; Irawan & Munir, 2021). These inconsistencies suggest that even elite athletes may experience difficulties in technical stability under varying conditions (Chen et al., 2023). Consistency needs to be emphasized in training programs by coaches to address these gaps and enhance overall performance consistency (Pope et al., 2018).

Finally, the current research points out the biomechanical analysis contribution to knowledge of petanque shooting technique and its optimization. If they know the most important kinematic variables and their interaction, coaches can develop evidence-based training plans that cater to the individual needs of every athlete. Apart from enhancing performance, this also reduces the risks of injury associated with inefficient technique.

CONCLUSION

This study provides valuable information on the petanque throwing biomechanics and areas of improvement with optimized training programs. With a focus on adaptive mechanisms during the backswing, swing speed, and release angles, athletes will be able to optimize their performance for any distance throw while being capable of providing technical consistency. The efficiency of shot styles decreases with distance, and the highest contribution is recorded at 7 meters (R Square 0.920) and lowest at 8 meters (R Square 0.556). The backswing angle and swing speed are most effective at short distances (6 meters) but lose much of their effectiveness at longer distances. Conversely, release angle is not stable at close to medium (6-7 meters) distance but decreases with greater distances. These results suggest that it is challenging for athletes to exhibit technical consistency with great distances. Therefore, the adaptive training method for instructing backswing development, swing speed, and releasing methods is crucial to improve performance of petanque players with various throwing conditions.

REFERENCES

Alis, M. N. F., Harmono, S., Pratama, B. A., & Indrayana, B. (2023). Development of Xander Resistance Training Exercise Model for Petanque Sports Branch at Student Level. Journal Coaching Education Sports, 4(2). https://doi.org/10.31599/jces.v4i2.3109

Asmawi, R. M., & Lubis, M. (2020). Petanque: Mental Training and Kines-thetic Perception of Shooting Accuracy. Journal of Physical Education, 9(3).

Chen, J., Kwok, A. P. K., & Li, Y. (2023). Effects of expertise in skill-oriented sports on postural control: An event-related potential study using dual-task paradigm. Neuroscience Letters, 812. https://doi.org/10.1016/j.neulet.2023.137408

Dinda Paulina, J., & Awang Irawan, F. (2022). Analisis Kesesuaian Gerak Pointing dengan Posisi Jongkok pada Olahraga Petanque. JOSSAE (Journal of Sport Science and Education) |, 7(1)

Fritch, J., Parekh, A., Labbe, A., Courseault, J., Savoie, F., Longo, U. G., De Salvatore, S., Candela, V., Di Naro, C., Casciaro, C., & Denaro, V. (2021). Biomechanics of the Throwing Shoulder. In Orthopaedic Biomechanics in Sports Medicine. https://doi.org/10.1007/978-3-030-81549-3_13

Helmi, B., Hidayah, T., Pramono, H., Hartono, M., & Iskandar, T. (2024). Using a Biomechanical Analysis Approach to the Accuracy of Shooting Throws in Petanque Sport: Literature Review. In Physical Education Theory and Methodology (Vol. 24, Issue 1). https://doi.org/10.17309/tmfv.2024.1.16

Irawan, F. A., & Munir, A. S. (2021). Analisis Backswing Dan Penggunaan Star Excursion Balance Test (SEBT) Terhadap Hasil Lemparan Shooting Petanque. JOSSAE Journal of Sport Science and Education, 6(2).

Kneblewski, A., Valdes-Tamayo, L., Laporte, S., Sandoz, B., Blanchard, S., & Rouch, P. (2020). Analysis of the biomechanical parameters of the lineout throwing performance under distance variable conditions in high level rugby players. Computer Methods in Biomechanics and Biomedical Engineering, 23(sup1). https://doi.org/10.1080/10255842.2020.1812855

Kurniawati, H. A., Kuswanto, H., Kimianti, F., & Pamungkas, W. (2019). Pengaruh Berat Beban pada Lengan terhadap Gaya Otot Bisep Sebagai Media Pembelajaran IPA Konsep Bioekanika. INDONESIAN JOURNAL OF APPLIED PHYSICS, 9(01), 16. https://doi.org/10.13057/ijap.v9i01.25544

Langeveld, A. R. J., Rustenburg, C. M. E., Hoozemans, M. J. M., Burger, B. J., & Meuffels, D. E. (2019). To Improve Your Surgical Drilling Skills, Make Use of Your Index Fingers. Clinical Orthopaedics and Related Research, 477(1). https://doi.org/10.1097/CORR.0000000000000557

Mkaouer, B., Jemni, M., Amara, S., Chaabène, H., Padulo, J., & Tabka, Z. (2014). Effect of three technical arms swings on the elevation of the center of mass during a standing back somersault. Journal of Human Kinetics, 40(1). https://doi.org/10.2478/hukin-2014-0005

Nurhasan, Al Ardha, M. A., Ristanto, K. O., Yang, C. B., Wijayanto, A., Pradana, S. W. K. C., Putra, N. S. R. P., Firmansyah, A., Bikalawan, S. S., Rizki, A. Z., & Utomo, R. S. (2024). Kinematic Movement Differences Between Petanque Pointing and Shooting Technique in Children. Retos, 52. https://doi.org/10.47197/RETOS.V52.97143

Phytanza, D. T. P., Burhaein, E., Indriawan, S., Lourenço, C. C. V., Demirci, N., Widodo, P., Widiyono, I. P., Irawan, Y. F., Sutopo, W. G., Parmadi, M., Azizah, A. R., Saleh, M., Hadiatmo, A., & Susanto, A. (2022). Accuracy Training Program: Can Improve Shooting Results of Petanque Athletes Aged 15-20 Years? International Journal of Human Movement and Sports Sciences, 10(1). https://doi.org/10.13189/saj.2022.100117

Pianigiani, S., & Villa, T. (2022). Biomechanical requirements for certification and quality in medical devices. In Human Orthopaedic Biomechanics: Fundamentals, Devices and Applications. https://doi.org/10.1016/B978-0-12-824481-4.00005-6

Schorah, D., Choppin, S., & James, D. (2015). Effects of moment of inertia on restricted motion swing speed. Sports Biomechanics, 14(2). https://doi.org/10.1080/14763141.2015.1027949

Solihin, S., Setyawati, H., & Hidayah, T. (2022). The Effect of Balance and Concentration Exercises on the Shooting Results of Petanque Riau Athletes. JUARA : Jurnal Olahraga, 7(3). https://doi.org/10.33222/juara.v7i3.2219

Yang, X. S. (2018). Optimization techniques and applications with examples. In Optimization Techniques and Applications with Examples. https://doi.org/10.1002/9781119490616