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# Attack Performance in Side-Out Phase - Complex I: Differences Between Winning and Losing Teams in the Men's Volleyball Nations League Finals 2025.

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**Abstract**

The purpose of this study was to analyze the technical characteristics of attack performance during Side-Out Phase - Complex I and to investigate differences between winning and losing teams participating in the final phase of the Men's Volleyball Nations League (VNL). The sample consisted of eight (N = 8) national teams that competed in the semifinal and final stages of the Men's VNL. A total of eight matches were analyzed, comprising 4,912 side-out attack actions. Data were collected through systematic video observation using a structured protocol with a five-point scale for each variable. Attack type, attack direction, and attack quality were examined. Statistical analysis was conducted using chi-square ($\chi^2$) tests to identify differences between winning and losing teams, with the level of significance set at $p < .05$. Statistically significant differences were found in favor of winning teams regarding powerful attacks, attack direction toward zones 5, 6, 7, and 8, and attack quality, particularly attacks leading to difficult defensive situations and direct points (kills). No significant differences were observed for softer attack types such as tips or finger shots. The findings highlight the decisive role of attack effectiveness in high-level men's volleyball. Winning teams demonstrated greater use of powerful attacks, more varied and targeted attack directions, and higher-quality attack outcomes. These results provide valuable insights for coaches and performance analysts aiming to optimize offensive strategies and training design in elite volleyball.

**Keywords:** volleyball, attack performance, side-out, match analysis, performance indicators

## 1. Introduction

Volleyball is considered a dynamic team sport in which competitive success depends on the combined effect of technical skills, tactical choices, and effective decision-making under time pressure (Sun & Zhang, 2026). Within this framework, the attack is regarded as one of the most decisive skills, as it is directly associated with scoring points and shaping the final match outcome (Mocanu, Harabagiu, & Parvu, 2024; Sitti, & Rangubhet, 2025).

The game sequence that begins with the serve and ends with the attacking action (side-out) has been recognized as a critical performance indicator in modern volleyball. Previous research has shown that attack effectiveness during the first game complex is one of the most important factors differentiating success from less successful teams, particularly in high-level competitions (Costa et al., 2014; Marcelino, Sampaio, & Mesquita, 2012).

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## 2. Literature Review

Attack performance is influenced by various parameters, such as attack type, attack direction, set quality, and the attacker's ability to adapt to the opponent's defensive organization. According to Afonso et al. (2010), attack speed and the diversification of offensive options limit the opponent's defensive organization, thereby increasing the likelihood of immediate point scoring. In addition, effective decision-making prior to attack execution has been associated with higher success rates (Suárez et al., 2020).

Special emphasis has also been placed on attack direction, which functions as a key tactical tool for exploiting weaknesses in the opponent's defense. Studies have shown that winning teams demonstrate greater variety and accuracy in selecting target zones, contributing to the creation of advantageous attacking conditions (Silva et al., 2016; Sitti & Rangubhet, 2025).

Despite the extensive literature on attack analysis, research examining differences between winning and losing teams in highly critical matches—such as the final stages of major international tournaments—remains limited (Peña, Rodríguez-Guerra, Busca & Serra, 2013). A systematic analysis of attack characteristics within Side-Out Phase - Complex I may provide useful insights both for scientific understanding and for optimizing coaching practice.

Therefore, the purpose of the present study was to record and analyze the technical elements of attack performance during Side-Out Phase - Complex I and to investigate differences between winning and losing teams that participated in the final phase of the Men's Volleyball Nations League.

## 3. Methodology

### Participants

The sample consisted of eight (N = 8) national teams (POL, ITA, BRA, SLO, FRA, JPN, CUB, CHN) that competed in the semifinal and final stages of the Men's Volleyball Nations League. A total of eight (N = 8) matches were observed and analyzed, including 4,912 attack actions within Side-Out Phase - Complex I. Technical elements were recorded through systematic observation using a structured protocol with a five-point scale for each variable.

### Instruments

Data collection was conducted using indirect observation with the aid of a video camera. A personal computer and Microsoft Excel were used to transfer the data to IBM SPSS v26, where statistical analysis was performed.

### Procedure

The video camera was positioned behind the court at an elevated point, approximately 15 meters from the end line. Each rally was recorded starting immediately after the serve and included reception, setting, and attack execution until the completion of the attacking action (Side-Out Phase - Complex I). The next recording began with the subsequent serve. Two trained observers conducted the observation process under standardized conditions. Intra-observer reliability was assessed by re-evaluating two matches on consecutive days, yielding a Pearson correlation coefficient of r = .72. Inter-observer reliability was evaluated by correlating the observations of both observers, resulting in a Pearson correlation coefficient of r = .76.

**Statistical Analysis**

Differences between winning and losing teams were analyzed using chi-square ($\chi^2$) tests for frequency data in IBM SPSS v26. The level of statistical significance was set at $p < .05$. Team outcome (winning vs. losing) was defined as the independent variable, while attack parameters within Side-Out Phase - Complex I were defined as dependent variables.

## 4. Results

Regarding attack type (Table 1), statistically significant differences were observed between winning and losing teams in favor of winning teams for powerful attacks ($p = .000$). No significant differences were found for other attack types.

**Table 1.** Type of Attack.

| Attack Type | $\chi^2$ value | Significance (p) |
|---|---|---|
| Powerful spike | $\chi^2 = 13.11$ | p = .000* |
| Wrist tip | $\chi^2 = 24.47$ | p = .514 |
| Finger tip | $\chi^2 = 31.18$ | p = .342 |
| Other | $\chi^2 = 0.40$ | p = .619 |

* Statistically significant difference ($p < .05$)

With respect to attack direction (Table 2 and Table 3), winning teams demonstrated significantly higher frequencies of attacks directed toward zones 5 ($p = .003$), 6 ($p = .002$), 7 ($p = .003$), and 8 ($p = .001$).

**Table 2.** Attack Direction (Court Zone).

| Attack Zone | $\chi^2$ value | Significance (p) |
|---|---|---|
| Zone 1 | $\chi^2 = 1.30$ | p = .422 |
| Zone 2 | $\chi^2 = 2.40$ | p = .311 |
| Zone 3 | $\chi^2 = 4.20$ | p = .523 |
| Zone 4 | $\chi^2 = 0.70$ | p = .441 |
| Zone 5 | $\chi^2 = 27.11$ | p = .003* |
| Zone 6 | $\chi^2 = 18.72$ | p = .002* |
| Zone 7 | $\chi^2 = 13.34$ | p = .003* |
| Zone 8 | $\chi^2 = 16.45$ | p = .001* |
| Zone 9 | $\chi^2 = 0.80$ | p = .724 |

* Statistically significant difference ($p < .05$)

**Table 3.** Numbering of Court Zones.

| Zone Number | Court Area |
|---|---|
| 1 | Right back |
| 2 | Right front |
| 3 | Middle front |
| 4 | Left front |
| 5 | Left back |
| 6 | Middle back |
| 7 | Deep left back |
| 8 | Deep middle back |
| 9 | Deep right back |

Concerning attack quality (Table 4), statistically significant differences in favor of winning teams were identified for attacks that resulted in difficult defensive situations and counterattacks ($p = .001$), as well as direct points scored through attack (kills) ($p = .000$).

**Table 4.** Attack Quality.

| Attack Outcome | $\chi^2$ value | Significance (p) |
|---|---|---|
| Error (out or blocked) | $\chi^2 = 0.40$ | $p = .521$ |
| Attack leads to easy counter-attack | $\chi^2 = 1.90$ | $p = .231$ |
| Attack leads to difficult defense and counter-attack | $\chi^2 = 15.24$ | $p = .001$* |
| Kill (direct point) | $\chi^2 = 17.43$ | $p = .000$* |
| Other | $\chi^2 = 1.20$ | $p = .442$ |

* Statistically significant difference ($p < .05$)

## 5. Discussion

The aim of the present study was to examine attack-related variables within Side-Out Phase I and to determine which factors contributed to match success among teams participating in the Men's VNL 2025. Attack effectiveness emerged as a decisive factor for competitive success, consistent with previous findings at the elite level.

Molina-Martín et al. (2022) demonstrated a clear relationship between attack quality and set outcome in elite men's volleyball, with winning teams committing fewer attack errors. Similarly, Drikos and Kountouris (2014) reported that teams winning close sets achieved significantly higher rates of direct attack points, emphasizing the critical role of attack under high-pressure conditions.

Beyond effectiveness, tactical choices preceding attack execution play a crucial role (Klaričić, Grgantov & Milanović, 2018). Conejero et al. (2017) highlighted that attack type,

direction, execution quality, and decision-making are strongly linked to overall performance and match outcome.

In terms of attack direction, previous studies have reported significant differences between winning and losing teams, with higher effectiveness observed when targeting specific zones of the opponent's court (Cieminski, 2018; Cojocaru & Cojocaru, 2019; Martins et al., 2021). In contrast, losing teams tended to rely more frequently on predictable and low-intensity attacking solutions.

Overall, the findings of the present study indicate that winning teams in the Men's NVL 2025 were characterized by greater use of powerful attacks, more diversified and targeted attack directions, and higher-quality attack outcomes. These results underline the importance of developing specialized offensive tactics and incorporating game-realistic training conditions to enhance attack performance.

The data derived from performance analysis studies can be effectively utilized in coaching practice, tactical preparation, and in-game decision-making, while also serving as indicators of contemporary performance trends in elite volleyball.

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