

Biomechanical Analysis of Instep Passing in Futsal: Body and Leg Angles Across Two Trials

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Abstract

Objectives: To describe body and leg angles during the approach, ball-contact, and follow-through phases of two instep passes performed by a futsal player.

Materials and Methods: This descriptive video analysis examined one sport education student performing two instep-pass trials. A mobile-phone camera recorded the player from the right side, and Kinovea 2023 1.2 was used to extract the angles reported in the original study and trial duration. Results were summarized descriptively; no inferential testing was conducted.

Results: At ball contact, body and leg angles were 141.1° and 65.8° in trial 1 and 142.2° and 76.1° in trial 2. Follow-through body and leg angles were 90.0° and 46.4° in trial 1 and 119.2° and 56.9° in trial 2. Recorded durations were 1.00 and 0.97 s, respectively.

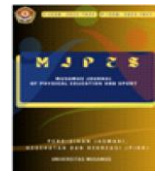
Conclusions: The two trials showed observable differences in movement configuration and a 0.03 s difference in recorded duration. These preliminary data can guide phase-specific technique observation but cannot establish a causal effect of joint angles on pass accuracy or effectiveness.

Keywords: biomechanics; futsal; instep pass; kinematics; video analysis

Introduction

Passing is a frequent technical action in futsal. The ability to direct the ball quickly depends on task demands as well as movement coordination. Studies of futsal kicking have examined lower-limb kinematics alongside ball speed and accuracy, showing why movement descriptors alone should be interpreted carefully (Barbieri et al., 2010; Vieira et al., 2017, 2019). Futsal passing is also affected by the constraints of the playing task (Oppici et al., 2018; Pizarro et al., 2021).

Biomechanical accounts of the instep kick describe coordinated movement of the trunk, support leg, and striking leg from the approach to follow-through (Lees et al., 2010). Support-limb action and foot placement can change the kicking sequence (Inoue et al., 2014; Augustus et al., 2017; Ou et al., 2023). Yet a single side-view recording captures only a projection of this three-dimensional action. The present study therefore describes the angles and duration reported for two instep passing trials, without treating the observations as a test of effectiveness.



Materials and Methods

Study Design

A descriptive, within-player video analysis was conducted. The unit of analysis was one observed pass, and the source manuscript reports two trials. No intervention, random allocation, control condition, or repeated-session reliability assessment was described.

Study Participants

One student from the 2021 cohort of the sport education program at Universitas Muhammadiyah Kalimantan Timur performed both trials. The source does not report age, sex, playing experience, dominant leg, recruitment procedure, or consent documentation; these details require confirmation from the authors.

Study Organization

A mobile phone recorded the player from the right side while performing two instep passes. The source describes an approach, a passing or contact phase, and a follow-through phase. Video frames were reviewed using Kinovea 2023 1.2 on a laptop. The original manuscript gives body and leg angles for each phase and one duration for each trial, but does not define the anatomical landmarks, exact frame selection, camera frame rate, camera distance, calibration, pass distance, ball state, or timing start and end points. Consequently, reported angles are retained as the source's operational measurements, rather than re-labelled as specific joint angles.

Statistical Analysis

The six phase-specific angle pairs and two recorded durations were compared descriptively. Differences between the second and first trial are arithmetic differences in observed values, not estimates of population effects. Accuracy, ball velocity, pass completion, and measurement error were not quantified.

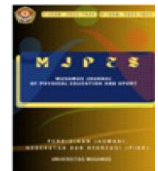
Results

Table 1 presents all angles reported in the source. At contact, trial 2 showed a body angle 1.1° greater and a leg angle 10.3° greater than trial 1. The largest recorded between-trial body-angle difference occurred during follow-through (29.2°).

Table 1. Body and leg angles across the two recorded instep-pass trials.

Phase and measure	Trial 1	Trial 2	Difference (2 – 1)
Approach, body angle	159.0°	158.8°	−0.2°
Approach, leg angle	31.6°	33.2°	+1.6°
Contact, body angle	141.1°	142.2°	+1.1°
Contact, leg angle	65.8°	76.1°	+10.3°
Follow-through, body angle	90.0°	119.2°	+29.2°
Follow-through, leg angle	46.4°	56.9°	+10.5°

The recorded duration was 1.00 s in trial 1 and 0.97 s in trial 2, a difference of 0.03 s. Because timing boundaries were not specified and only two trials were available, this difference cannot be interpreted as a reliable performance improvement.



Discussion

The observed changes across phases are consistent with the general view that an instep kick is a coordinated whole-body action, but the present angles cannot identify its mechanical cause. Lees et al. (2010) describe contributions from the approach, upper body, support leg, and foot–ball interaction. Inoue et al. (2014) specifically examined support-leg dynamics, while an intervention by Augustus et al. (2017) showed that modifying support-leg action can alter maximal instep-kick performance. Ou et al. (2023) likewise examined support-foot placement. These studies justify recording the support foot and torso in future analyses; they do not establish that either angle in the present two trials was optimal.

The distinction between movement configuration and pass quality is important. Barbieri et al. (2010) and Vieira et al. (2019) paired futsal kicking kinematics with ball velocity or accuracy, whereas Vieira et al. (2017) found that kicking success was too variable to be fully explained by a small set of strength and kinematic measures. Bertozzi et al. (2025) showed that foot dominance and approach angle affect whole-body instep-kick kinematics. Thus, the larger leg angle and shorter recorded duration in trial 2 are observations, not evidence that the ball travelled faster or reached the intended teammate more accurately.

A 0.03 s difference is particularly sensitive to event definitions, frame rate, and normal trial-to-trial variability. Lees and Rahnema (2013) documented typical error in repeated maximal instep kicks; a comparison of two trials without repeatability estimates cannot separate technical change from normal variation. Maly et al. (2018) also observed changes in kicking speed and accuracy after physical loading, illustrating how task conditions may alter results. Future protocols should record pass accuracy and ball velocity, standardize fatigue and approach conditions, and collect multiple trials.

The observational setup can be useful for teaching technique, provided the limits of a single camera are recognized. Shishov et al. (2021) found that camera perspective and calibration affect Kinovea-derived body-segment estimates in a different movement task, while Carzoli et al. (2022) evaluated agreement of Kinovea with another measurement system in resistance exercise. Faj et al. (2025) reported validation of two-dimensional Kinovea tracking for countermovement jumps. Those validation results cannot be transferred directly to futsal passing, but support explicit camera positioning, calibration, and rater checks before interpreting small angular or time differences.

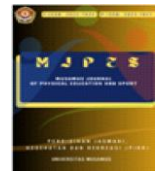
Finally, the practical meaning of the observed technique depends on the game task. Oppici et al. (2018) demonstrated that futsal task constraints affect the learning and transfer of passing skill, and Pizarro et al. (2021) examined how small-sided-game constraints shape passing decisions. The present isolated, two-trial analysis cannot characterize passing under opponent pressure. A larger study should combine repeatable phase measurements with target-hit data, ball speed, player characteristics, and match-relevant passing conditions.

Conclusions

One player exhibited different body and leg angles across two instep-pass trials, and the recorded duration decreased from 1.00 to 0.97 s. The evidence supports a descriptive comparison of movement phases only. Claims that a particular angle improved passing accuracy, force, or effectiveness require objective performance measures and a larger, standardized design.

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Conflict of Interest

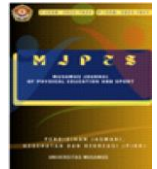
Author confirmation of potential conflicts of interest is required before submission.

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References

- Augustus, S., Mundy, P., & Smith, N. (2017). Support leg action can contribute to maximal instep soccer kick performance: An intervention study. *Journal of Sports Sciences*, 35(1), 89–98. <https://doi.org/10.1080/02640414.2016.1156728>
- Barbieri, F. A., Gobbi, L. T. B., Santiago, P. R. P., & Cunha, S. A. (2010). Performance comparisons of the kicking of stationary and rolling balls in a futsal context. *Sports Biomechanics*, 9(1), 1–15. <https://doi.org/10.1080/14763141003690211>
- Bertozi, F., Rabello, R., Zago, M., Esposito, F., & Sforza, C. (2025). Foot dominance and ball approach angle affect whole-body instep kick kinematics in soccer players. *Sports Biomechanics*, 24(2), 306–326. <https://doi.org/10.1080/14763141.2022.2110514>
- Carzoli, J. P., Sousa, C. A., Helms, E. R., & Zourdos, M. C. (2022). Agreement between Kinovea video analysis and the Open Barbell System for resistance training movement outcomes. *Journal of Human Kinetics*, 81, 27–39. <https://doi.org/10.2478/hukin-2022-0003>
- Faj, L., Aleksić, J., & Knežević, O. M. (2025). From laboratory to field: Concurrent validity of Kinovea's linear kinematics tracking tool for semi-automated countermovement jump analysis. *Sensors*, 26(1), 24. <https://doi.org/10.3390/s26010024>
- Inoue, K., Nunome, H., Sterzing, T., Shinkai, H., & Ikegami, Y. (2014). Dynamics of the support leg in soccer instep kicking. *Journal of Sports Sciences*, 32(11), 1023–1032. <https://doi.org/10.1080/02640414.2014.886126>
- Lees, A., Asai, T., Andersen, T. B., Nunome, H., & Sterzing, T. (2010). The biomechanics of kicking in soccer: A review. *Journal of Sports Sciences*, 28(8), 805–817. <https://doi.org/10.1080/02640414.2010.481305>
- Lees, A., & Rahnama, N. (2013). Variability and typical error in the kinematics and kinetics of the maximal instep kick in soccer. *Sports Biomechanics*, 12(3), 283–292. <https://doi.org/10.1080/14763141.2012.759613>
- Maly, T., Sugimoto, D., Izovska, J., Zahalka, F., & Mala, L. (2018). Effect of muscular strength, asymmetries and fatigue on kicking performance in soccer players. *International Journal of Sports Medicine*, 39(4), 297–303. <https://doi.org/10.1055/s-0043-123648>
- Oppici, L., Panchuk, D., Serpiello, F. R., & Farrow, D. (2018). Futsal task constraints promote transfer of passing skill to soccer task constraints. *European Journal of Sport Science*, 18(7). <https://doi.org/10.1080/17461391.2018.1467490>
- Ou, Y. C., Lei, M. K., & Cheng, K. B. (2023). Effect of support foot placement on football instep kick performance. *Science and Medicine in Football*, 7(1). <https://doi.org/10.1080/24733938.2022.2055781>
- Pizarro, D., Práxedes, A., Travassos, B., Gonçalves, B., & Moreno, A. (2021). How informational constraints for decision-making on passing, dribbling and shooting change with the manipulation of small-sided games changes in futsal. *Perceptual and Motor Skills*. <https://doi.org/10.1177/00315125211016350>
- Shishov, N., Elabd, K., Komisar, V., Chong, H., & Robinovitch, S. N. (2021). Accuracy of Kinovea software in estimating body segment movements during falls captured on standard video: Effects of fall direction, camera perspective and video calibration technique. *PLOS ONE*, 16(10), e0258923. <https://doi.org/10.1371/journal.pone.0258923>



Vieira, L. H. P., de Souza Serenza, F., de Andrade, V. L., de Paula Oliveira, L., Pamplona Mariano, F., Santana, J. E., & Santiago, P. R. P. (2017). Kicking performance and muscular strength parameters with dominant and nondominant lower limbs in Brazilian elite professional futsal players. *Journal of Applied Biomechanics*. <https://doi.org/10.1123/jab.2016-0125>

Vieira, L. H. P., Cunha, S. A., Santiago, P. R. P., Dos Santos, P. C., Cardenas, G. C., Barbieri, R. A., Baptista, A. M., & Barbieri, F. A. (2019). Dominant/non-dominant support limb kinematics and approach run parameters in futsal kicking of stationary and rolling ball. *The Journal of Sports Medicine and Physical Fitness*, 59(11), 1852–1860. <https://doi.org/10.23736/S0022-4707.19.09654-3>