E-ISSN: 2708-4523
P-ISSN: 2708-4515
Impact Factor (RJIF): 5.61
AJMC 2026; 7(1): 180-182

www.allcommercejournal.com
Received: 02-10-2025
Accepted: 07-11-2025

Vo Minh Hieu
Faculty of Sport Science, Ton Duc Thang University, Ho Chi Minh City, Vietnam

Tran Cao Cam Tien
Faculty of Sport Science, Ton Duc Thang University, Ho Chi Minh City, Vietnam

Corresponding Author:
Tran Cao Cam Tien
Faculty of Sport Science, Ton Duc Thang University, Ho Chi Minh City, Vietnam

Descriptive analysis of shoulder joint kinematics during the backswing phase in amateur golfers

Vo Minh Hieu and Tran Cao Cam Tien

DOI: https://www.doi.org/10.22271/27084515.2026.v7.i1c.980

Abstract
The golf swing places high rotational demands on the shoulder complex, yet shoulder motion during the backswing in amateur golfers remains insufficiently described. This study aimed to descriptively examine shoulder joint kinematics during the backswing phase in amateur golfers. Five right-handed amateur golfers performed ten driver swings each, resulting in 50 analyzed swings. Shoulder motion was recorded using a motion analysis system, and four left shoulder variables were examined, including shoulder abduction, adduction, horizontal abduction, and horizontal adduction. The results showed limited frontal-plane shoulder motion, with mean abduction and adduction of approximately ±4.5°, and substantial transverse-plane shoulder rotation, with mean horizontal shoulder motion of approximately ±94°. Movement patterns were consistent across swings. These findings suggest that amateur golfers primarily rely on horizontal shoulder motion rather than vertical arm elevation during the backswing. The study provides baseline biomechanical data that may support future research and coaching strategies related to golf swing technique and injury prevention.

Keywords: Golf swing biomechanics, shoulder kinematics, backswing phase

Introduction
The golf swing is a highly coordinated whole-body movement that imposes substantial rotational demands on multiple joints, particularly the shoulder complex. According to the prior research data, shoulder injuries account for about 18% of the cases reported, whereas low back pain is the most frequent injury among golfers, making up as much as 34% of all golf-related injuries [3, 4, 6]. These damage patterns emphasize how crucial it is to comprehend the kinematic contributions of the shoulder complex and trunk during the golf swing, especially during high rotational demand phases like the Backswing.

The X-factor is defined the rotational distance between the shoulders and the pelvic girdle, is one of the most often researched biomechanical factors in golf from a performance standpoint. It has been demonstrated that this separation is crucial for producing trunk rotational velocity and, eventually, ball velocity [7, 8]. The relative motion between the thorax and the shoulders has historically been regarded as insignificant. Recent research, however, calls into question this presumption. Axial rotation inside the shoulder complex contributed more than 40% of the total shoulder-pelvis rotational separation at a position near the apex of the backswing, according to an exploratory research using medical imaging [1]. Overly dependent on shoulder or spinal mobility may raise mechanical stress, which may contribute to both low back discomfort and shoulder injuries due to the significant inter-individual heterogeneity in the relative contributions of the spine and shoulders.

Therefore, it is essential to comprehend the rotational biomechanics of the golf swing in order to maximize performance and minimize injuries [11]. Although trunk and pelvic mechanics have been the focus of earlier studies, shoulder motion's precise contribution - especially in novice golfers - is still not well understood. In order to provide baseline biomechanical data that may support future research and guide coaching strategies targeted at increasing swing efficiency while lowering injury risk, the goal of this study was to descriptively analyze shoulder joint motion during the backswing phase in amateur golfers.

Materials and Methods
This study employed a cross-sectional descriptive design to document and characterize shoulder joint kinematics during the backswing phase of the golf swing in amateur golfers.

The study sample consisted of five right-handed amateur golfers with regular training and competitive experience. All participants voluntarily agreed to participate, were in good health, and reported no history of shoulder injury at the time of data collection. Each participant performed 10 shots using a Iron club, resulting in a total of 50 analyzed swings, which were used to represent the consistency of swing mechanics and measurement stability. No training intervention was implemented, no comparisons between groups were conducted, and no causal relationships between variables were examined.

Fig 1: Experimental setup for shoulder kinematic data collection

Shoulder kinematics were recorded using the Noraxon Ultium motion analysis system, employing inertial measurement units (IMUs) attached to the relevant body segments in accordance with the manufacturer's guidelines. Prior to data collection, participants completed a standardized warm-up protocol and subsequently executed their swings under controlled practice conditions. All swing trials were recorded continuously, and kinematic data were exported and processed using Noraxon analysis software. The primary variables analyzed included four left shoulder (LT) kinematic variables, corresponding to the lead shoulder in right-handed golfers: shoulder abduction and shoulder adduction in the frontal plane, as well as shoulder horizontal abduction and shoulder horizontal adduction in the transverse plane. The backswing phase was identified based on the temporal progression of shoulder motion within the swing cycle. Descriptive statistics, including minimum, maximum, and mean values, were calculated to summarize shoulder joint motion at the backswing. No inferential statistical analyses were performed. The results are presented descriptively to provide baseline biomechanical data for future studies investigating golf swing performance.

Results and Discussion

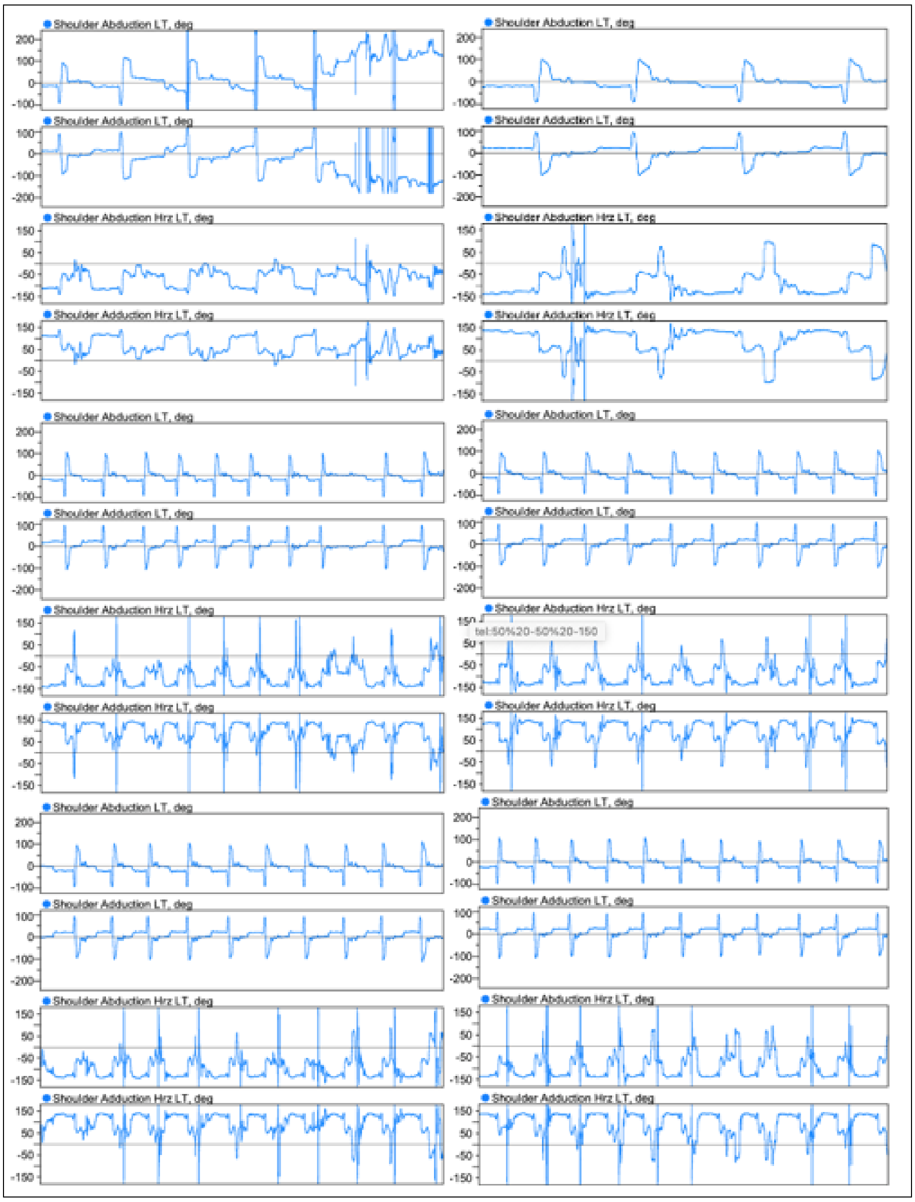

Fig 2: LT kinematic time-series during the backswing phase across repeated golf swing

The descriptive analysis revealed distinct characteristics of shoulder joint motion during the backswing phase in amateur golfers. Frontal-plane shoulder movement remained limited across the 50 analyzed swings, whereas transverse-plane motion was substantially larger and more consistent. Specifically, mean left shoulder adduction during the backswing was 4.5 ± 1.2°, with values ranging from 3.0° to 6.0°, while mean shoulder abduction was -4.5 ± 1.2°, ranging from -6.0° to -3.0°. These narrow ranges indicate minimal vertical arm displacement during this phase of the swing (Table 1).

In contrast, shoulder motion in the transverse plane demonstrated markedly greater angular magnitudes. Mean horizontal adduction of the lead shoulder reached 93.8 ± 1.3°, with values ranging from 92.9° to 96.2°, whereas mean horizontal abduction reached -93.8 ± 1.3°, ranging from -96.2° to -92.9°. Despite the amateur status of the participants, the relatively small standard deviations observed across all variables suggest a high degree of movement consistency across repeated swings (Figure 2).

Table 1: Descriptive statistics of left shoulder kinematic variables at the backswing phase (N = 50)

	Mean ± SD (º)	Min (º)	Max (º)
Shoulder Abduction LT	-4.5 ± 1.2	-6.0	-3.0
Shoulder Adduction LT	4.5 ± 1.2	3.0	6.0
Shoulder Abduction Hrz LT	-93.8 ± 1.3	-96.2	-92.9
Shoulder Adduction Hrz LT	93.8 ± 1.3	92.9	96.2

Note: Negative values (-) for shoulder abduction indicate posterior arm movement relative to the torso in the horizontal plane, whereas positive values (+) for shoulder adduction indicate anterior arm movement

The dominance of transverse-plane shoulder motion indicates that the backswing in amateur golfers is achieved primarily through horizontal rotation of the lead arm relative to the torso rather than through vertical arm elevation. The minimal frontal-plane angles observed in this study suggest that shoulder elevation contributes little to backswing positioning in this cohort. Instead, horizontal shoulder displacement appears to be the primary mechanism for accumulating rotational displacement prior to the downswing.

These findings align with biomechanical perspectives emphasizing the importance of rotational mechanisms within the upper body during the golf swing. While trunk-pelvic separation has traditionally been used to describe rotational capacity, emerging evidence indicates that motion occurring within the shoulder complex itself can contribute substantially to total upper-body rotation near the top of the backswing. The consistently large horizontal shoulder angles observed in the present study further support the view that shoulder kinematics represent an active component of rotational movement, even among amateur golfers.

From an injury-prevention standpoint, the observed movement pattern warrants consideration. Given the inter-individual variability in trunk mobility, golfers who rely heavily on shoulder rotation to achieve backswing positioning may experience increased mechanical loading at the shoulder joint. This compensatory strategy may be particularly relevant for amateur golfers, whose movement patterns and physical capacities may differ from those of elite players. Although causal relationships cannot be established due to the descriptive design, the present findings provide baseline biomechanical information that may inform future investigations into swing efficiency, shoulder loading, and injury risk.

Conclusion

In this study, amateur golfers' shoulder joint kinematics during the backswing phase were descriptively examined. The findings revealed significant transverse-plane shoulder rotation, with mean horizontal shoulder abduction and adduction of around ±94° throughout 50 studied Golf swings, and restricted frontal-plane shoulder motion, with mean shoulder abduction and adduction of about ±4.5°. Stable backswing mechanics were demonstrated by the consistency of these movement patterns across multiple trials. The results indicate that during the backswing, amateur golfers primarily rely on horizontal shoulder motion rather than vertical arm elevation. The current study advances a better biomechanical knowledge of the golf swing by offering baseline quantitative data on shoulder participation. It may also help future research and coaching approaches targeted at increasing swing efficiency while lowering injury risk.

References

1. Bourgain M, Sauret C, Rouch P, Thoreux P, Rouillon O. Evaluation of the spine axial rotation capacity of golfers and its distribution. J Hum Kinet. 2016;50(Suppl 1):S1-S77.
2. Burden AM, Grimshaw PN, Wallace ES. Hip and shoulder rotations during the golf swing of sub-10 handicap players. J Sports Sci. 1998;16(2):165-176.
3. Cole MH, Grimshaw PN. The crunch factor's role in golf-related low back pain. Spine J. 2014;14(5):799-807.
4. Gluck GS, Bendo JA, Spivak JM. The lumbar spine and low back pain in golf: A literature review of swing biomechanics and injury prevention. Spine J. 2008;8(5):778-788.
5. Matsui K, Shimada K, Andrew PD. Deviation of skin marker from bone target during movement of the scapula. J Orthop Sci. 2006;11(2):180-184.
6. McHardy A, Pollard H. Lower back pain in golfers: A review of the literature. J Chiropr Med. 2005;4(3):135-143.
7. McHugh MP, O'Mahoney CA, Orishimo KF, Kremenic IJ, Nicholas SJ. Importance of transverse plane flexibility for proficiency in golf. J Strength Cond Res. 2022;36(2):e49-e54.
8. Myers J, Lephart S, Tsai YS, Sell T, Smoliga J, Jolly J, *et al*. The role of upper torso and pelvis rotation in driving performance during the golf swing. J Sports Sci. 2008;26(2):181-188.
9. Perron C, Rouillon O, Edouard P. Epidemiological study on injuries and risk factors for injuries in the amateur golfer French high-level. Ann Phys Rehabil Med. 2016;59:e20.
10. Raabe ME, Chaudhari AM. An investigation of jogging biomechanics using the full-body lumbar spine model: Model development and validation. J Biomech. 2016;49(7):1238-1243.
11. Steele KM, Roh EY, Mahtani G, Meister DW, Ladd AL, Rose J, *et al*. Golf swing rotational velocity: The essential follow-through. Ann Rehabil Med. 2018;42(5):713-721.