

Influence of lead foot rotation on external joint moments during golf swing in elderly amateurs with knee arthroplasty and young high-skilled players

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Summary

Adjusting lead foot rotation influenced external joint moments during the swing differently in high-skilled and amateur players. The increased frontal plane knee moments do not support the previous recommendation of 30° lead foot rotation to reduce the risk of knee osteoarthritis (OA). However, external foot rotation was able to reduce lead knee flexion moments. Knowledge how to alter joint loading in amateur and high-skilled players could help prevent injuries.

Introduction

Despite the low-impact nature of golf, a review identified that most golfers have an increased lifetime risk of musculoskeletal injury [1], especially to the lumbar spine or lower extremities [2]. The golf swing generates substantial joint moments often exceeding those during daily activities [3]. Understanding joint loading during the golf swing is thus essential for injury prevention, effective rehabilitation, especially since several lower extremity pathologies have been linked to excessive joint moments [3]. Externally rotating the lead foot could reduce frontal plane knee torques and the risk of knee OA [4,5], but the corresponding impact on hip and lumbar spine moments remains unclear. Given that joint moments correlate with skill level [6], the influence of lead foot rotation could differ in high-skilled vs. amateur golfers. Therefore, this study assessed the influence of lead foot rotation on knee, hip and lumbar spine loading during the golf swing in golfers with two skill levels.

Methods

11 elderly amateur players with total knee arthroplasty in the lead leg (69.6±8.8 yrs; 2♀/9♂; 83.6±15.5 kg; 1.78±0.08 m; months post-op 43.7±11.9, handicap: n=4 for 0-18, n=5 19-28, n=2 >29), and 14 young high-skilled golf players (29.4±7.3 yrs; 14♂; 73.5±11.9 kg; 1.78±0.06 m; handicap 5.0±4.3) were analyzed during golf swings with different lead foot rotations: straight with 0° (0ST) vs. 30° external rotation (30ER). Motion capture relied on an optical marker-based system, the IfB marker set [7] and two force plates. The external joint moments in knee, hip and lumbar spine were calculated using a quasistatic inverse approach involving

functional joint centers, ground reaction forces, gender-specific segment masses and normalized to body mass [9].

Results and Discussion

30ER increased frontal and transverse plane peak moments in the lead hip for high-skilled, in the lead knee for both skill levels, but decreased lead knee peak flexion moments in high-skilled players (Table 1). Lead knee flexion moment was decreased shortly before impact (Fig 1). Trail leg peak moments were only influenced for knee extension in amateurs, and for knee flexion in the high-skilled using a driver. The influence on peak lumbar moments was only seen in an increased extension moment for 30ER for high-skilled players using a driver. Based on the increased frontal plane moments, the present findings do not support the recommendation [4,5] of a 30°-rotated lead foot to reduce the risk for knee OA. However, since the 30ER stance reduced lead knee peak flexion moment, it may be better for patients with knee extensor weakness or knee instability.

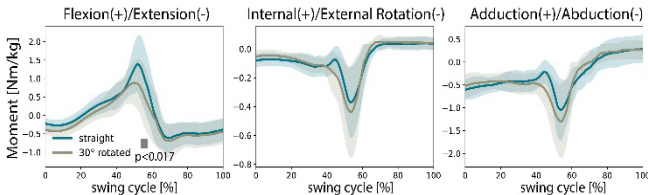


Figure 1: External lead knee joint moments for high-skilled golfers using an iron-6 club, comparing straight to 30° lead foot rotation

Conclusions

An understanding of the influence of stance modification on joint loading during golf can help instructors tailor their approach to prevent pain/injury and enhance recovery.

References

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Table 1: External peak knee joint moments of the lead knee normalized to body mass. Mean and SD. * significant with p<0.008

[Nm/kg]		Flex	Ext	Add	Abd	Int Rot	Ext Rot
Amateur TKA	30° rot	1.18±0.34	-0.80±0.46	0.77±0.31*	-0.39±0.12*	0.17±0.09	-0.17±0.05*
	straight	1.28±0.41	-0.78±0.36	0.53±0.22*	-0.23±0.12*	0.12±0.07	-0.09±0.03*
High skilled	30° rot	1.52±0.33*	-1.05±0.39*	0.39±0.21	-2.09±0.47*	0.09±0.05	-0.70±0.23*
	straight	1.97±0.41*	-0.91±0.34*	0.43±0.25	-1.61±0.43*	0.09±0.04	-0.58±0.17*
High skilled	30° rot	1.69±0.43*	-1.03±0.42	0.37±0.23	-2.64±0.63*	0.08±0.05	-0.91±0.21*
	Driver	straight	2.16±0.46*	-0.87±0.36	0.34±0.22	-2.11±0.63*	0.07±0.05