Effects of Hip Focused Training on Rehabilitative Single-Leg Hop Outcomes: A Pilot Study

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SUMMARY

The single-leg hop test (SLH) is a widely used tool for assessing readiness to return-to-play, focusing on hop distance and landing stability. This study compares the effects of two training protocols: a combined training group (COMB), which includes eccentric and plyometric training, and an eccentric-only training group (ECC), on SLH performance. After four weeks of training, the COMB group demonstrated significantly greater improvements in hop distance than the ECC group. Kinematic analysis revealed that during landing, the center of mass (COM) sagittal displacement increased in both groups. However, the COMB group exhibited greater peak knee flexion angles and reduced COM frontal displacement, resulting in softer, more stable landings. These findings suggest that combined eccentric and plyometric training effectively enhances lower limb functional movement and reduces re-injury risk, making it an essential component of late-stage rehabilitation programs.

INTRODUCTION

Determining readiness to return to play during the final stage of rehabilitation is essential. The single-leg hop (SLH) test, widely used for its simplicity, primarily evaluates hop distance and landing stability. The hip joint and surrounding muscles play a critical role in generating power during the push-off phase and stabilizing the pelvis, trunk, and knee during landing. This study aims to investigate the effects of different hip training protocols on SLH performance, including hop distance, landing stability, and lower limb kinematics during landing phases in healthy athletes. By establishing performance benchmarks and training standards for healthy athletes, the findings may guide rehabilitation strategies to improve return-to-play efficiency in injured athletes.

METHODS

Two Division I ball sport athletes, aged 25 and 27, were assigned to a combined training group (COMB) and an eccentric training group (ECC), completing twice-weekly sessions over four weeks. Both participants had no significant lower limb injuries in the past six months. The training protocols focused on hip muscles with identical total loads.

The dominant leg was tested, and hop distance was normalized to leg length. Key variables, including peak knee flexion angle and center of mass (COM) sagittal and frontal displacement during the landing phase, were captured using an infrared high-speed camera and force plate. The landing phase was defined from initial contact (vertical GRF >20N) to peak knee flexion. Data was collected three times: pre-training, at the 2nd week, and at the 4th week, on the second day after the last training session of that week.

RESULTS AND DISCUSSION

After four weeks training, both groups achieved further hop distance, while COMB (0.1480±0.003) showed over all greater improvements than ECC (0.1437±0.032) (Figure 1). In addition, during landing phase, COMB demonstrated gradually greater peak knee flexion angle, increased COM sagittal plane displacement and reduced COM frontal plane displacement than pretest (Table 1).

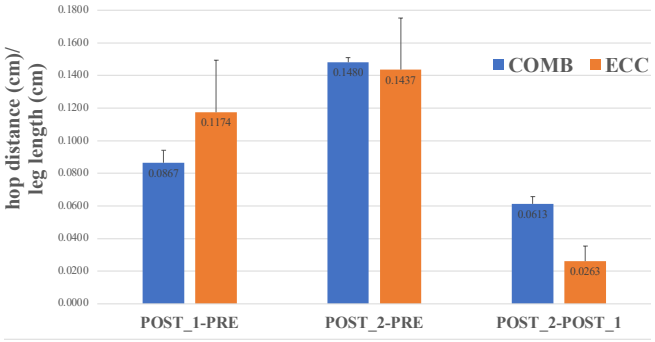

Figure 1: Distance changes between pretest, the 2nd and 4th weeks. COMB, combined training group; ECC, eccentric training group; PRE, pretest; POST_1, the 2nd week; POST_2, the 4th week

Table 1: Landing phase kinematic parameters

	COMB (n=1)			ECC (n=1)		
	PRE	POST_1	POST_2	PRE	POST_1	POST_2
peak knee flexion (°)	73.55±3.96	79.23±5.22	81.16±4.35	56.19±1.85	52.62±4.53	62.78±3.57
COM sagittal displacement (cm)	29.27±3.44	32.56±1.38	33.26±1.39	19.57±2.10	24.91±0.94	33.85±2.64
COM frontal displacement (cm)	2.11±0.79	1.54±0.99	1.43±0.27	1.21±0.65	1.72±1.33	2.33±0.67

COMB, combined training group; ECC, eccentric training group
PRE, pretest; POST_1, the 2nd week; POST_2, the 4th week

Muscle strength is not the only factor associated with injury risk; neuromuscular control also plays an essential role, which is why eccentric training and plyometric training have been increasingly emphasized. With greater peak knee flexion angle and increased COM sagittal plane displacement, COMB demonstrated the ability to convert impact force through the lower limb to the trunk and absorb it over a broader range. Furthermore, reduced COM frontal plane displacement reflected improved lateral movement control, minimized body sway, and a lower risk of lower limb injuries.

CONCLUSIONS

The combination of eccentric and plyometric training (COMB) is more effective in improving lower limb functional movement while reducing re-injury after return-to-play and could be added to the last stage of the rehabilitation.

REFERENCES

[1] Kasmi et al. (2021). *The effects of eccentric and plyometric training programs and their combination on stability and the functional performance in the post-ACL-surgical rehabilitation period of elite female athletes. Frontiers in Physiology*, **12**: 688385