Different platform slopes affect proximal and distal hamstring activities and joint angles during Nordic hamstring exercise

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Summary

This study aimed to compare the activities in the proximal and distal regions of the biceps femoris long head muscle (BFlh) during the Nordic hamstring exercise (NHex) using different slopes on the platform. Fifteen male volunteers performed isometric NHex with three different slope angles (0°, 20°, and 40°) by extending the knee as far as possible and maintaining isometric contraction for 5 seconds. The normalized integral electromyographic data (NiEMG) obtained for the proximal and distal BFlh regions under each condition were analyzed. A repeated-measures ANOVA was performed to compare the BFlh region activities with the different slopes. The distal BFlh activity was significantly higher than the proximal BFlh activity at 40°. Performing NHex at a 40° angle may be beneficial for focusing on the distal BFlh region.

Introduction

Isometric NHex, performed using an inclined platform at a shallow knee flexion angle, enhances the activity of the middle region of the BFlh, which is more vulnerable than other biarticular hamstring muscles to sprint-type hamstring strain injuries [1]. However, the largest tissue strains exist near the proximal myotendinous junction of the BFlh, where acute injury often occurs [2]. The activities in the BFlh proximal and distal regions during use of an inclined platform remain unclear. The purpose of this study was to compare the muscle activities between the proximal and distal BFlh regions during the NHex using different slopes in the platform.

Methods

Fifteen male volunteers (age, 21.2±2.4 years; height, 178±7.6 cm; body mass, 79.2±14.5 kg) performed isometric NHex with three different slope angles (0°, 20°, and 40°) by extending the knee as far as possible and maintaining isometric contraction for 5 seconds. The proximal and distal BFlh regions were marked at 40% and 70% of the vertical distance line between the greater trochanters. An inertial measurement unit was used to monitor the angles of the ankle, knee, and hip joints. The electromyographic data obtained for proximal and distal BFlh under each condition were analyzed and normalized by the data collected during maximal voluntary isometric contraction of each muscle, creating NiEMG data. A repeated-measures ANOVA was performed to compare the BFlh region activities with the different slopes. Significant main effects were followed up by Holm post-hoc procedures. Significance was set at $P<0.05$.

Results and Discussion

There was a significant main effect related to the slope and BFlh region ($F=3.354$; $\eta^2=0.025$; $P=0.042$). The proximal BFlh NiEMG activity during NHex at 0° was significantly higher than that at 40° ($d=1.27$; $P<0.001$). The proximal BFlh activity at 20° was significantly higher than that at 40° ($d=0.985$; $P<0.001$). Moreover, the distal BFlh activity was significantly higher than the proximal BFlh activity at 40° ($d=-0.981$; $P=0.041$). One possible explanation could be that the proximal BFlh region is more engaged in hip extension than the distal BFlh region when attempting to maintain a straight upper body [3].

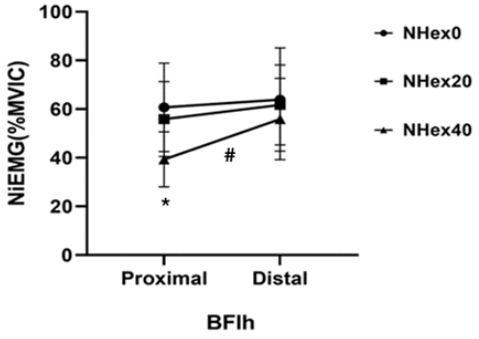

Figure 1: Differences in NiEMG (%MVIC) activity during isometric NHex with different platform slopes (0°, 20°, and 40°). *Significant difference between NHex40. #Significant difference between the proximal and distal regions..MVIC= maximal voluntary isometric contraction.

NHex variations	Joint angle (degrees; mean ± SD)		
	Hip flexion	Knee flexion	Ankle dorsiflexion
NHex 0°	11.6±14.6	60.0±27.8	-8.6±4.5
NHex 20°	7.7±18.8	37.6±14.9	-8.0±5.3
NHex 40°	5.5±17.9	4.9±29.4	-14.0±23.8

Table 1: Joint angles of ankle dorsiflexion, knee flexion, and hip flexion (degrees). *Significant difference between NHex0°. **Significant difference between the NHex20°and NHex40°.

Conclusions

The present findings suggest that performance of NHex at a 40° angle may be beneficial for focusing on the distal region of the BFlh, which is especially vulnerable during sprinting and associated with hamstring strain injuries.

References

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