A Comparison of the Effectiveness of Active versus Passive Warm-up in Improving Hamstring Flexibility in Healthy College Students

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**Introduction**

- Hamstring strains are among the most common musculotendinous injuries of the lower extremity. The etiology may be associated with insufficient warm-up.
- Bandy et al. demonstrated a significant improvement in hamstring flexibility in response to repeated stretching that was of 30 seconds duration over a 4 week period of time.
- Several studies have demonstrated the reliability of the passive knee extension test for measuring hamstring flexibility. Others have used this position for static stretching.

**Purpose**

- The purpose of this study was to determine the most effective warm-up method for preparing the hamstrings for 8 sessions of passive stretching in healthy, college students. The results of this study may impact the standard of care for optimizing the effects of passive stretching within Athletic Training and related health professions.

**Methods**

- Subjects (n=16, 8 female, 8 male, 18-22y) were randomly assigned to one of 3 groups: 1) Control: no warm-up, 2) Passive Warm-up: moist heat to hamstrings in prone x 15 min prior to stretching, 3) Active Warm-up: stationary bike riding x 15 min at age-adjusted target HR prior to stretching.
- All subjects received stretching to bilateral hamstrings (in varied order) 30 sec x 5 with 10 sec rest (Figure 1).
- The Passive Knee Extension Test (PKE) (Figure 2) was performed in a double-blinded fashion using a blinded goniometer (Figure 3) before and immediately following warm-up and hamstring stretching.
- Results revealed clinical significance for both control and active warm-up groups.

**Results**

- One-way ANOVA (p<.05) (95%CI) revealed a statistically significant difference when comparing pre- versus immediate post-stretch for all three groups (Figure 4). A Bonferroni post hoc test indicated that the active warm-up group revealed a statistically significant improvement compared with the other groups.
- Baseline v. Final PKE measurements were compared using independent t-Tests (2-tailed) and revealed improvement in all 3 groups with the greatest change in the active warm-up group, however, these changes were not statistically significant (control: 5.59, active: -11.99, passive: -6.73) (Figure 5).
- The minimal clinically important difference (MCID) for ROM ranges from 4-9 degrees. Baseline v. Final results revealed clinical significance for both control and active warm-up groups.

**Conclusion**

- Improvement in hamstring flexibility may be achieved upon stretching with or without warm-up, however, the most significant changes were achieved with use of active warm-up.
- The optimal effects of active warm-up may be attributed to an overall increase in tissue temperature facilitated by repeated muscle activity and/or a neurophysiologic effect resulting in hamstring inhibition.
- Future studies should enlist more subjects and subjects with known hamstring impairment. Comparing different types of active warm-up and alternate parameters for stretching may also be useful in identifying optimal methods for improving hamstring flexibility.
- Active warm-up may be considered preferable to the use of moist heat or the absence of warm-up in optimizing the effects of hamstring stretching in healthy college students.

**References**