African Journal of Biomedical Research, Vol. 8 (2005); 79 - 82
ISSN 1119 – 5096 © Ibadan Biomedical Communications Group
Available online at http://www.bioline.org.br/md

Full Length Research Article

The Effects of Static Stretch Duration on the Flexibility of Hamstring Muscles

ODUNAIYA N.A., *HAMZAT T.K., AJAYI O.F.

Department of Physiotherapy College of Medicine, University of Ibadan, Ibadan, Nigeria;

Received: November, 2004
Accepted: February, 2005

Abstract
The effects of duration of a static stretching protocol (Intervention) on hamstrings tightness were evaluated. Sixty purposively sampled subjects with unilateral hamstring tightness that had no history of low back and lower extremity dysfunctions that necessitated medical intervention participated in the study. They were randomly assigned into one of 5 intervention and one control groups. Groups a, b, c, d, e subjects had their hamstrings passively stretched for 120, 90, 60, 30, and 15 seconds respectively, while group f served as control. This intervention was carried out on alternate days for 6 consecutive weeks. Knee extension deficit (KED) was measured for all groups at baseline, weekly and 7 days post cessation of the intervention (carry-over). Data were analysed using one-way ANOVA and paired t-test at 0.05 alpha. A significant reduction ($P<0.05$) was observed in the KED of subjects in all the intervention groups across the 6 intervention weeks. There was no significant difference between the immediate post intervention and carry-over KED values ($p>0.05$). The study shows that statically stretching tight hamstrings for any duration between 15 and 120 seconds on alternate days for 6 weeks would significantly increase its flexibility. The effect was also sustained for up to 7 days post intervention.

Key Words:
Stretching, Hamstrings, Flexibility, Exercise and Duration.

INTRODUCTION

The ability of an individual to move smoothly depends on his flexibility, an attribute that enhances both safety and optimal physical activities. The hamstrings are example of muscle groups that have a tendency to shorten (Turner et al, 1988). A tight hamstring causes increased patellofemoral compressive force, which may eventually lead to patellofemoral syndrome. Flexibility can be enhanced by simple, non-surgical procedures like stretching the shortened muscles. Stretching techniques such as cyclic stretching (Turner et al, 1988), isometric exercise (Medeiros et al, 1977), proprioceptive neuromuscular facilitation protocol and static stretching (Worrell et al, 1994) have been used to enhance muscular flexibility. One of the factors that may likely affect the outcome of the non surgical intervention is the duration for which any of the techniques is applied. The questions answered in this study are:

(a) Would the duration of applying static stretching exercise procedure have a significant effect on hamstrings tightness?
(b) Would the effects of the static stretch procedure be sustained for up to seven days post intervention?

MATERIALS AND METHODS

Subjects
Sixty subjects (37 males and 23 females) with unilateral hamstrings tightness ranging in age from 18 to 30 years were purposively sampled at the University of Ibadan, Nigeria. Hamstring tightness was determined as knee extension deficit (KED) using the active knee extension test (AKET). They did not have any history of neurological abnormality, and previous injuries or disorders of the lower back or lower extremities.
The procedure was adequately explained to the subjects before obtaining their informed

consents. All the procedures in this study complied with the Ethical Principles for Medical Research Involving Human Subjects i.e. the Helsinki declarations as amended. The consenting subjects agreed that they would not engage in any other lower limb exercises aside the one designed for this study for the six-week period.

They were then randomly assigned, using simple random technique, into one of the six groups. The groups and the duration for each stretching exercise procedure were as follows:

Group I: Performed static stretch exercise for 120 seconds.
Group 2: Performed static stretch exercise for 90 seconds.
Group 3: Performed static stretch exercise for 60 seconds.
Group 4: Performed static stretch exercise for 30 seconds.
Group 5: Performed static stretch exercise for 15 seconds.
Group 6: Served as control and thus did not participate in the static stretch exercise procedure.

Procedure of data collection

Baseline Measurement: The baseline knee extension deficiency (KED) was measured using a double-arm goniometre with 0.97 reliability value (Bandy et al, 1998). The subject performed the active knee extension test procedure as described by Spernoga et al (2001). Each subject wore a pair of shorts, to avoid any restriction to movement in the lower limb. The greater trochanter, the fibula head and the lateral malleolus of the subject were marked with a felt-tipped pen, and served as anatomical landmarks for the goniometric assessment.

Each subject was positioned supine on the plinth and the hip of the lower limb being assessed was flexed to 90^{o}. The distal part of the anterior surface of the thigh was placed in contact with the cross-line of a specially constructed wooden frame. With his ankle in relaxed position, and ensuring that his thigh maintained contact with the cross line on the wooden frame, the subject was instructed to actively extend the knee to the point where he started feeling a stretch. The knee extension deficiency (KED) was measured using the goniometre. Zero degree was considered to be full extension of the knee.

The hamstring was then taken through the static stretching exercise as indicated below.

Stretching Protocol

After determining the baseline value, the subjects were taken through the stretching exercise training for the duration specific for the group to which s/he belonged. The stretching exercise was carried out as follows: -

Starting Position**:** Subject assumed the full supine-lying position on a plinth with his two feet pointing upwards. The contra-lateral lower limb was securely strapped to the plinth using 2 slings positioned across the thigh and over the anterior superior iliac spine to stabilize the pelvis. The lower limb being stretched was passively moved into the extreme of extension, up to the limit where the subject felt a gentle stretch at the posterior aspect of the thigh. This placed the hamstring muscles at their greatest possible length. The stretch was sustained at this point for the assigned duration for each group e.g. 15 seconds, 30 seconds.

The procedure was carried out on alternate days for 6 consecutive weeks in the intervention groups only. The KED was determined weekly for all the subject groups.

Post stretch Measurement: After assessing the subjects at the 6^{th} week of the stretching exercise (post intervention), a 7-day rest interval was observed. The subject's KED was then re-assessed at the 7^{th} day post intervention and recorded as "carry-over" values.

Data Analysis

Descriptive statistics of range mean and standard deviation were computed on all the data. One-way ANOVA was calculated across all the groups over the 6 weeks of the study. A paired t-test was computed to compare the post intervention and carry over values. Level of significance was set at 0.05 alpha.

RESULTS

The mean physical parameters of the subjects are as shown in Table 1. There was no significant difference in the baseline knee extension deficiency (KED) of the subjects when compared across the 6 groups ($f = 0.33$; $P>0.05$) as shown in Table 2. There was however a significant difference in the post 6-weeks KED across the 6 groups ($f = 4.920$; $P<0.05$) as shown in table 2. Only group 6 (control) subjects did not show any significant difference in their KED over the six-week period. Comparison of the post intervention and carryover values using t-test showed no significant difference ($p>0.05$) in the values for each of the 6 groups (Table 3).

Table 1
Physical Characteristics of the Subjects in Each Group (N=60).

Group	Age (Yrs) X±S.D	Weight (Kg) X±S.D	Height (M) X±S.D
1 (n=10)	23.20 ±2.57	60.2 ±6.44	1.72 ±0.08
2 (n=10)	23.40 ±1.67	58.67 ±6.87	1.70 ±0.06
3 (n=10)	24.67 ±1.87	58.52 ±5.77	1.68 ±0.05
4(n=10)	24.20 ±1.81	58.60 ±6.42	1.77 ±0.07
5 (n=10)	23.60 +2.55	61.60 +7.62	1.74 +0.08
6 (n=10)	22.30 ±2.11	50.80 ±8.08	1.59 ±0.14

Table 2: The Baseline and Post Intervention Knee Extension Deficit (Ked) of the Subject (N=60).

Group	Baseline X±S.D	Post Intervention Ked X±S.D
1 (n=10)	41.70±9.45	30.00±7.13
2 (n=10)	39.80±7.63	29.80±8.83
3 (n=10)	36.70±7.12	28.00±10.82
4(n=10)	40.50±6.40	28.80±9.60
5 (n=10)	43.70±5.64	33.65±5.05
6 (n=10)	44.20±10.62	44.70±10.88
f-ratio	0.33	4.92
P-Level	>0.05	<0.05

DISCUSSION

Flexibility is an important physiological component of physical fitness, and reduced flexibility can cause inefficiency in the workplace and is also a risk factor for low back pain. Increasing hamstring flexibility was reported to be an effective method for increasing hamstring muscle performance on selective isokinetic conditions (Worrell et al, 1994).

The technique of relieving hamstring tightness used in this study was to passively and statically stretch the hamstring muscles. This procedure lasted between 15 and 120 seconds (depending on the group to which the subject belonged), four times a week and for 6 consecutive weeks. The outcome of this study revealed that the application of static stretching exercise procedure resulted in significant improvement in hamstrings muscle flexibility in all the intervention groups. The implication of this finding is that an individual with hamstrings tightness would benefit from static stretching for any time duration between 15 and 120 seconds. This observed trend is similar to that of an earlier study by Chan et al (2001) who reported that static stretching protocols of either 4 or 8 weeks are effective in terms of improving flexibility of hamstrings. The mechanism of action is that static stretching exercise causes plastic stretching which results in irreversible tissue elongation (Turner et al, 1988).

Whereas a 30 and 60 second stretch had been reported to be more effective than a 15 second stretch (Bandy and Irion, 1994); our findings have shown that none of the 5 stretching exercise duration was more effective than the others. The trend of result obtained in this study is significant considering the fact that several authors had chosen different time durations ranging from 15 to 120 seconds (Charis et al, 1985; Madding et al, 1987 and Etnyre et al, 1988) with little evidence on the most effective duration.

We observed that the achieved level of increased hamstrings flexibility was sustained by the 5 intervention groups up to 7 days post completion of the intervention procedure. This implies that the effects of the stretching were long-lasting enough to be sustained for 7 days. Our findings however contrast with that of Turner et al (1988). The dissimilarities between the 2 studies could be a result of the difference in the frequency and the duration for which the static stretching exercise were carried out. While the procedure was carried out 4 times a week for 6 consecutive weeks in our study (24 sessions), the previous study by Turner et al (1988) administered the stretching for 5 consecutive days only.

Clinical Implications of Findings

Muscle tightness is a limiting factor for optimal physical performance and an important intrinsic factor for sports injury. One of the remedial approaches to muscle tightness is stretching procedures such as static stretching exercise protocol. Static stretching has been reported as a therapeutic tool in preventing injuries associated with lack of flexibility as well as in treatment of sports injuries (Hamzat et al, 2004). Many authors have studied different approaches of muscle stretching and the duration of application of such procedures (Worrell et al, 1994; Bandy and Irion, 1994; and Spernoga et al, 2001). However there was no consensus in the reports of these authors on what would be the most effective duration of application.

Our findings show that a 15-second stretch is just as effective as a 30, 60, 90, or 120 second stretch when the procedure is carried out over a period of 6 consecutive weeks. We therefore concluded that in order to increase the hamstrings flexibility in athletes and others and treat sports injuries, there is no need to subject individuals with hamstring tightness to more than 15 seconds of static stretching exercise protocol.

Table 3: Comparison of Post-Intervention and Carry-Over Ked Values of the Subjects (N=60).

	Group1 (n=10)	Group 2 (n=10)	Group3 (n=10)	Group 4 (n=10)	Group 5 (n=10)	Group 6 (n=10)
Post Intervention	30.00±7.13	29.80±8.83	28.00±10.82	28.80±9.60	33.65±50.5	44.70±10.88
Carry Over-Value	31.40±8.10	30.40±8.72	29.00±12.30	30.30±10.07	36.10±6.52	44.90±10.92
t-Value	1.02	1.62	2.10	2.17	2.16	0.61
p-Level	>0.05	>0.05	>0.05	>0.05	>0.03	>0.05

Key: KED = Knee Extension Deficit

REFERENCES

Bandy W.D., Irion J.M. and Briggler M. (1998). The effect of static stretch and dynamic range of motion training on the flexibility of hamstring muscles. *J Orthop Sports Phys Ther* 29(4), 295-300

Bandy W.D. and Irion J.M. (1994). The effects of time of static stretch on the flexibility of the hamstring muscles. *Phys Ther* 74: 845-856

Chan S.P., Hong Y, and Robinson P.D. (2001). Flexibility and passive resistance of the hamstrings of young adults using two different static stretching protocols. *Scand J Med Sci Sports* 11(2):81-86

Charis D, Bohannon R.W. and Larkin P. (1985). Effectiveness of repeated prolonged loading for increasing flexion in knee demonstrating post operative stiffness. A clinical report. *Phys* Ther 65:494-496

Etnyre B.K. and Lee E.J. (1988). Chronic and acute flexibility of men and women using three different stretching techniques. *R Q* 59, 222-228

Hamzat T.K., Adeniyi A.F., Awolola O.E. and Olaleye O.A. (2004). Injury pattern of FIFA, CAF and UEFA soccer tournaments: A retrospective study of selected 2002 matches. *S A Journal of Physiotherapy* 60(3), 10-14.

Madding S.W., Wong J.G., Halloo A and Medeiros J.M. (1987). Effects of duration of passive stretching on hip adduction range of motion. *J Orthop Sports Phys Ther* 8, 409-416

Medeiros J.M., Smidt G.L., Burmeiser L.F. and Soderberg G.L (1977). The influence of isometric exercise and passive stretch on hip joint motion. *Phys Ther* 57:518-522

Spernoga S.G., Uhl T.L., Arnold B.L. and Gansneder BM (2001). Duration of maintained hamstrings flexibility after a one time, modified hold-relax stretching protocol. *J Athl Train* 36(1): 44-46

Turner D, Gossman R.M., Nicholson C.G and Lemons J (1988). Comparison of cyclic and sustained passive stretching using a mechanical device to increase resting length of hamstring muscles. *Phys Ther* 69(3): 314-320

Worrell TW, Smith T.L. Winegardner J (1994). Effect of hamstring stretching on hamstring muscle performance. *J Orthop Sports Phys Ther* 20(3):154-159

* Address for Correspondence:
Dr.T.K.Hamzat, Department of Physiotherapy, College of Medicine, University of Ibadan, P.M.B 5017 GPO Dugbe Ibadan,Nigeria. Tel: 234-2-8101995; tkhamzat@comui.edu.ng