

The Effect of Mulligan Traction Straight Leg Raise in Participants with Short Hamstrings

T Hall,¹MSc, K Anuar,²BHlthSc (Phy), MSportsPhysio, B Darlow,³BPhy, MSportsPhysio, P Gurumoorthy,⁴BSc (Phy) (Hons), MSportsPhysio, M Ryder,⁵BSc (Phy), MSportsPhysio, T Smith,⁴BPhy, MSportsPhysio

Introduction

Background

Hamstring strains are a common athletic injury. Increasing hamstring flexibility is a common goal for athletes, coaches and sports medicine clinicians. Appropriate muscle flexibility assists in preventing or minimising injuries, as well as enhancing performance.

The straight leg raise (SLR) test is used to assess hamstring length. Flexibility is represented by the angular measurements of unilateral hip flexion with the knee in full extension.

Manual techniques developed by Brian Mulligan are used in clinical settings worldwide. The Mulligan Traction Straight Leg Raise (MTSLR) technique is a single, painless intervention with immediate effect. This technique has not been investigated in terms of its effectiveness in improving SLR range of motion (ROM) or the duration of improvement in a population with short hamstrings.

Objectives

To determine if the MTSLR technique can improve SLR ROM in subjects with short hamstrings and if any improvement is maintained 24 hours after the intervention. Secondly, to determine whether any improvement is due to a change in hip flexion or posterior pelvic rotation.

Materials and Methods

Study Design

A prospective, randomised, double blind, placebo-controlled 24-hour follow-up intervention study design was used.

Participants

Forty-seven volunteers were recruited. Participants were required to be 18-40 years old and have a first onset of a stretching sensation in the posterior thigh at <SLR 70°. Participants were excluded if they had a history of hamstring strain, low back pain with referral into the leg, SLR limited by symptoms within or distal to the popliteal fossa, unable to achieve full knee extension or SLR <40°. Participants were randomised to either a MTSLR (n = 24) or placebo group (n = 23). The mean age was 23 years (SD 5.7) for intervention and 21.4 years (SD 3.0) for placebo group. The mean SLR ROM was 54.8° (SD 11.1) for intervention and 54.7° (SD 11.5) for placebo group. There were no significant differences between both groups for age ($P = 0.249$) or SLR ROM ($P = 0.968$).

A sample of 23 participants in each group was required to provide an 80% power to detect a 12-degree change. This change was selected to represent a clinically significant increase in SLR based on the effect size demonstrated by a study of a normal population.

Three participants from each group were lost to follow-up. An independent sample t-test showed no significant differences in the dependent variables of these six participants ($P > 0.05$). One participant was withdrawn from the study after he complained of pins and needles behind his knee during the intervention.

The participants indicated which technique they thought they had received to assess the effectiveness of the blinding procedure. There was no significant difference in the number of participants who perceived they had received MTSLR in the intervention (n = 12) and placebo (n = 8) groups ($X^2 = 1.6$; $df = 1$, 40; $P = 0.343$).

Equipment

Participants were fitted with an ankle-foot orthosis (AFO) and a knee extension splint. Two plinths were placed together, with a board in between. The participant lay supine with one leg on either side of the board. A 10-cm bar was fixed to the AFO at the heel. This bar extended medially and kept in contact with the board to ensure the limb remains in the sagittal plane during SLR measurements.

SLR ROM was measured using two bubble inclinometers. One inclinometer was attached to the pelvis to measure posterior pelvic rotation. The second was attached to the knee to measure SLR ROM. Hip flexion range was calculated by subtracting the pelvic rotation range from the SLR ROM.

The participants were instructed to allow their limb to be raised passively and to indicate the point at which they felt the first onset of stretch. The SLR was performed four times to minimise any increase attributed to the repetitive stretch of the muscle-tendon unit. Measurements were recorded on the fifth, sixth and seventh repetitions. One investigator raised the limb throughout the investigation, while another recorded all inclinometer readings. These investigators were blinded to the participants' group allocation.

A reliability study was performed on 7 participants independent of the study. The intra-session intra-class correlation coefficient (ICC_{3,3}) was 0.99 ($P < 0.001$) for total SLR range and 0.99 ($P < 0.001$) for pelvic rotation range. The inter-session ICC_{3,3} was 0.99 ($P < 0.001$) for total SLR range and 0.99 ($P < 0.001$) for pelvic rotation range.

Procedure

The MTSLR and placebo techniques were performed in a separate room by a third investigator. The leg was raised into flexion until the participant noted the onset of stretch. The MTSLR involved applying a sustained traction to the limb followed by internal or external rotation, or abduction or adduction. If the stretch was decreased, the limb was raised further into flexion. The placebo technique involved SLR until the onset of stretch followed by a calf squeeze.

Data Analysis

The datum was analysed using SPSS version 11.0. One-sample Kolmogorov-Smirnov test was used to establish normality. Two-way ANOVA test was used to analyse the datum with group and testing time as the independent variables and SLR ROM as the dependent variable. One-way repeated measures ANOVAs were performed for each group in order to identify whether any change in SLR overtesting time was due to hip flexion or posterior pelvic rotation ROM. The alpha value was set at 0.05.

¹ Lecturer, School of Physiotherapy, Curtin University of Technology and Manual Concepts, Australia

² Physiotherapist, Physiotherapy Department, Tan Tock Seng Hospital Pte Ltd, Singapore

³ Clinical Tutor, Victoria Physiotherapy Clinic and School of Physiotherapy, University of Otago, New Zealand

⁴ Physiotherapist, Australia

⁵ Physiotherapist, Connect Physical Health, Newcastle, United Kingdom

Address of Correspondence: Mr Khalid Anuar, Blk 484, #14-63, Admiralty Link, Singapore 750484.

Results

There was a significant increase in SLR across testing times. Tests of within subject contrasts showed a significant increase in SLR ROM between pre-test and post-test ($P < 0.001$), and between pre-test and follow-up ($P = 0.003$). The mean increase in SLR ROM at post-test was 6.3° (SD 5.98°) for the intervention and 4.7° (SD 4.97°) for the placebo group. However, this increase was not significantly different between both groups ($P = 0.349$).

Posterior pelvic rotation was significantly increased at post-test in both intervention ($P = 0.001$) and placebo ($P = 0.001$) groups. This was maintained at follow-up in both intervention ($P = 0.028$) and placebo ($P = 0.007$) groups. Hip flexion was significantly increased at post-test in the intervention group ($P = 0.014$), but not the placebo group ($P = 0.099$). Hip flexion was not significantly different at follow-up in the intervention ($P = 0.945$) or placebo ($P = 0.455$) group.

Discussion

The increase in SLR ROM in the intervention group at post-test was due to an increase in both hip flexion and posterior pelvic rotation, whereas the increase in the placebo group was due only to posterior pelvic rotation. This suggests that the MTSLR had an effect on hamstring flexibility; however, the magnitude (hip flexion increase $\sim 3^\circ$) is not clinically relevant.

The significant increase in SLR ROM in both groups is unlikely to be due to measurement error as intra- and inter-session measures were found to be highly reliable ($ICC_{3,3} = 0.99$).

The large number of SLRs that were performed during testing was designed to eliminate the viscoelastic properties of muscle. It is unlikely that the increase in range was due to the repeated SLR application, as all SLRs were limited to the first subjective onset of stretch and were maintained for only a few seconds for recording measurements.

The measurements may have been influenced by the participants' anxiousness about receiving a novel technique. Participants were informed of the aims of the study through informed consent and, therefore, expected an increase in SLR ROM as a result of intervention. This may have led to an expectation-conditioning adjustment. A

Pavlovian response is unlikely to explain the results as the intervention was only applied once. This study was unable to demonstrate the true magnitude of any placebo effect as the participants were effectively blinded to their group allocation.

There was difficulty controlling participants' athletic activity prior to recruitment. SLR ROM may have appeared higher due to the presence of post-exercise muscle stiffness at initial testing. Recruiting participants 24 hours before initial testing may have controlled this confounding effect.

A study on a normal population found a significant increase in SLR ROM (13.3°) following the application of the MTSLR technique, which was greater than the 6.3° observed in the current study. The normal population study may have experimenter expectancy bias and good subject effect, as it did not have a placebo or control group. The investigators also did not perform any warm-up SLRs before measurements.

Clinical Implications

Even though the improvement in SLR through the application of MTSLR may be related to a placebo effect, it may still be an effective technique. Future research should investigate the MTSLR in comparison to a no-intervention control group using a single-blind study design with blind measurers to effectively evaluate the placebo effect.

The large standard deviation in SLR increase in the intervention group at post-test and follow-up indicates that MTSLR had a large effect on some participants. Research should be directed at further defining the appropriate population that MTSLR should be applied to. Additional research could also investigate MTSLR in comparison to other stretching techniques, as a multiple intervention, or in a population with abnormal neurodynamics.

Conclusion

This study demonstrated that the MTSLR technique does not improve SLR ROM more than a placebo technique in a population with short hamstrings. Both groups had a significant increase in SLR ROM at post-test and follow-up measures; however, it is questionable whether the small increases are clinically significant.

Prevalence, Awareness and Control of Hypertension in Community-dwelling Elderly in Singapore

HK Ho,¹MBBS, M Med (Fam Med), SK Cheong,²MBBS, M Med (Fam Med), DGM, CW Siew,³MBBS, DGM, BY Tan,⁴MSc (Med Stat), FS Lim,⁵MBBS, M Med (Fam Med), DGM, SC Emmanuel,⁶FAMS, MBBS, MSc

Introduction

The prevalence of hypertension in the elderly has been quoted to range from 43% to 65% in Asia^{1,2} and some parts of Europe.^{3,4} In the National Health Survey 1998,⁵ prevalence of hypertension in Singapore was 27.3% in the 30-69 years' age group, but a very high 64.3% in the 60-69 years' age group. Amongst this high prevalence is another issue of awareness: up to 53% of these hypertensives were not previously known.⁵

Recognising the epidemiological transition from infectious to chronic non-communicable diseases, the Singapore government adopted a countrywide approach⁶ and since the 1990s, initiated various national health promotion⁷ and screening programmes.⁸

While treating hypertension may be one of the commonest clinical responsibilities of physicians, only 1 in 4 patients have their blood pressure adequately controlled.⁹ With Singapore slated to be one of the fastest ageing society, it is important to know the local prevalence of this cardiovascular risk factor and the current situation in terms of hypertension in community-dwelling elderly more than 65 years old and to explore some related issues.

Materials and Methods

The study was conducted over a period of 1 month from November to December 2002 in a suburban housing estate of Toa Payoh Central. Toa Payoh Central was chosen as the elderly population there was 11%,¹⁰ which is close to the current estimate of elderly population in Singapore. Furthermore, the ethnic distribution was 81% Chinese, 11% Malay and 7% Indian, closely resembling the current national ethnic distribution.

Out of an estimated 9000 households, 2300 households, stratified by housing type, were randomly selected by the Department of Statistics, Singapore. Of these, 346 households were excluded as these were either shophouses, from a private estate where the management declined participation or blocks designated to be demolished. Of the remaining 1954 households, there were no elderly in 1092 households (55.9%) and a one step replacement was done for these. During replacement, the same unit two floors below were chosen. When the unit happened to be on the second floor, the unit on the top floor was replaced. If the unit two floors below was already selected, another unit 4 floors below was chosen.

Of the 1954 households, 227 were not occupied and another 309 were not contactable despite making 3 visits at different times of the day. Some 151 households refused participation and 4 were not available, either on vacation, staying with another child or hospitalised during the period of study. A total of 171 households participated in the study.

A total of 921 households were replaced and, eventually, 60 households participated in the study. The overall household participation rate, considering households with elderly only, was

50.2%. The 231 (171 ± 60) households which participated in the study yielded 270 questionnaires, but 5 were excluded due to inaccurate or incomplete data. Finally, 265 elderly participated in the study.

A team of medical students were recruited, trained and sent to the homes of these elderly. A questionnaire was administered and it covered the medical and social history, such as a history of diabetes, stroke, ischaemic heart disease, smoking, alcohol consumption and living arrangements. The question on hypertension invited 4 responses: "hypertension on medication", "hypertension not on medication", "no history of hypertension" or "don't know". Where possible, the medications were recorded and correlated with the history given and the primary physician noted.

Blood pressure was taken twice after an oral interview, in the sitting position and using Omron T5 sphygmomanometer, and the average of both readings recorded.

The statistical package used was SPSS version 11.5.0. Chi-square test was used to evaluate significance of proportion.

Results

The prevalence of hypertension was 55.5% (n = 147) (Table I). The majority (63.3%) of those who had a history of hypertension were female. There was no dominance of any particular race in the hypertensive or non-hypertensive group. A history of hypertension was also positively associated with a history of diabetes and ischaemic heart disease. The mean age (± standard deviation) for both groups was similar: the hypertensive group was 72.6 ± 6.1 compared to 72.7 ± 6.1 in the non-hypertensive group.

Close to half (47.6%, n = 70) of those with hypertension were followed up at a polyclinic, 31.3% (n = 46) were followed up by private general practitioners and 17.0% (n = 25) followed by private or public hospitals.

TABLE I: SELECTED CHARACTERISTICS OF ELDERLY WITH AND WITHOUT HYPERTENSION

Variable	Hypertension (n = 147)		No hypertension (n = 104)		P
	n	(%)	n	(%)	
Male	54	(36.7)	55	(52.9)	0.011
Race					
Chinese	128	(87.1)	85	(81.7)	0.603
Malay	9	(6.1)	11	(10.6)	
Indian	8	(5.4)	6	(5.8)	
Others	2	(1.4)	2	(1.9)	
Alcohol drinker	13	(8.8)	15	(14.4)	0.158
Smoker	27	(18.4)	45	(43.3)	<0.001
History of stroke	15	(10.2)	7	(6.7)	0.330
History of diabetes	45	(30.6)	17	(16.3)	0.010
History of ischaemic heart disease	39	(26.5)	10	(9.6)	0.001

¹ Doctor-in-charge, Choa Chu Kang Polyclinic, National Healthcare Group Polyclinics, Singapore

² Deputy Doctor-in-charge, Ang Mo Kio Polyclinic, National Healthcare Group Polyclinics, Singapore

³ Family Doctor, Bukit Batok Polyclinic, National Healthcare Group Polyclinics, Singapore

⁴ Senior Manager, Health Information Management, National Healthcare Group Polyclinics, Singapore

⁵ Director, Medical Affairs, National Healthcare Group Polyclinics, Singapore

⁶ Chief Executive Officer, National Healthcare Group Polyclinics, Singapore

Address of Correspondence: Dr Ho Han Kwee, Choa Chu Kang Polyclinic, 2 Teck Whye Crescent, Singapore 688846.

The blood pressure readings of 246 out of 265 elderly, based on their history of hypertension, is presented in Table II. Using 140/90 mm Hg as a cut-off, 26.6% of elderly with hypertension had good control. The corresponding figure, using 160/90 mm Hg as a cut-off, was 54.0%.

TABLE II: BLOOD PRESSURE READING OF COMMUNITY-DWELLING ELDERLY

Variable	Blood pressure control level			Total
	<140/90 mmHg	≥140/90 to 160/90 mmHg	≥160/90 mmHg	
Hypertension/on medication	35	32	52	119
Hypertension/not on medication	2	6	12	20
No hypertension	33	26	34	93
Do not know	5	5	4	14
Total	75	69	102	246

There was no correlation between the level of control and the principal physician (Pearson's coefficient = 0.351). Neither was there a correlation between the level of control and race ($P = 0.409$), gender ($P = 0.090$), history of stroke ($P = 0.694$), ischaemic heart disease ($P = 0.068$) or diabetes ($P = 0.702$).

The potential rate of undiagnosed hypertension, using 160/90 mm Hg and 140/90 mm Hg as cut-offs, was 15.4% and 28.0%, respectively. There were slightly more males (51.7%) who had potentially undiagnosed hypertension but this was not statistically significant ($P = 0.584$). There was no relationship between those with potentially undiagnosed hypertension and race ($P = 0.42$).

Discussion

The finding that more than one in two of our community-dwelling elderly has hypertension highlights not just how common this cardiovascular risk factor is, but how seriously we should view the management of this condition. With a rapidly ageing society and a more sedentary and stressful lifestyle in the 40- to 64-year-old age group, this figure, both in terms of percentage and absolute numbers, can only be expected to increase. When hypertension is poorly managed, the resulting mortality and morbidity can be a huge medical and economic burden on our ageing society.

Our study showed that race and gender had little to do with hypertension or its level of control. This simplifies the picture, but complicates the strategy as no one particular group can be targetted for more focused action. This could also suggest a more fundamental underlying factor cutting across gender and race: our lifestyle in modern Singapore.

The lower rate (28%) of undiagnosed hypertension compared to the 53% recorded in 1998 by the National Health Survey, can probably be attributed to aggressive public education and community health screening undertaken by the relevant authorities. The next

challenge in hypertension management would appear to be showing the same reversal of proportions of those whose blood pressure is within target range. Close to 80% ($47.6\% \pm 31.3\%$) of those with hypertension were followed up by primary care physicians from both the public and private sectors and the emphasis should be on this group of doctors. The primary care physician often faces difficulties like compliance (often confounded by patients attributing unrelated symptoms to hypertensive medications), mindset and the delicate balance between cost and medications. This is particularly true as better control of hypertension often entails the use of more than one antihypertensive medication.⁹ While the practical difficulties of controlling hypertension should be acknowledged, a change in mindset on the part of the doctor that the elderly can be "allowed" to have higher blood pressure should be discouraged. Blood pressure monitoring at home should be encouraged to rule out white coat hypertension and postural fall in blood pressure actively looked for. Clinical judgement on a case-by-case basis is emphasised but, as far as possible, treatment of hypertension in the elderly can be more proactive and the patient encouraged to take ownership of his or her own health.

In conclusion, while national screening programmes and public education seem to be showing results with the apparent fall in the number of cases of undiagnosed hypertension, more proactive management and education are still necessary to improve the level of control and to bring about true disease prevention of this very important cardiovascular risk factor.

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