

A Study to Design a Flexibility Device for Calf Muscle Stretching for Muscle Tightness - A Pilot Study

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Abstract: Purpose of Study: Stretching is an important therapeutic for increasing joint ROM. Jean E Cromie et al, did a study to see the work-related musculoskeletal disorders (WRSDs) in physical therapists and concluded that the lifetime prevalence of WRSD 91%, and 1 in 6 physical therapists moved within or left the profession as a result of WRSDs. Margaret molumphy et al, determined work-related back pain among physical therapists as work includes lifting with sudden maximal effort, bending, and twisting activities. So, the need of the study is to design flexibility device to stretch and cure tightness by providing mechanical stretching and decreasing the incidence of WRSDs. Methodology: The flexibility device has been designed with help of a biomedical engineer. Thirty subjects between the ages of 25 to 50 years who fulfill all inclusion criteria along with a positive flexibility test of calf muscles were recruited for the study. All subjects have taken passive manual stretching treatment for one leg and mechanical stretching treatment with the use of flexibility devices in another leg. Flexibility measurement has done after treatment. The difference in pre-and post-data has been measured for the study. Statistical analysis was performed by SPSS software. Results: There is no significant difference observed between the two groups. Conclusion: The flexibility device is helpful to treat tightness of the calf muscle. Work-Related Musculoskeletal Disorders (WRSDs) can be managed by using this device.

Keywords: Work-Related Musculoskeletal Disorders (WRSDs), Stretching, Flexibility Device, Calf

1. Introduction

Physical fitness is a state of being that reflects a person's ability to perform specific exercises or functions and is related to present and future health outcomes. In the United States, serious efforts to assess the physical fitness of youth with a battery of tests began in the 19th century. These efforts intensified during times of war and focused primarily on improving athletic performance and military preparedness. Over time, the focus of such surveys shifted to assessing health rather than performance, reflecting growing concern about the current and future health of the nation's youth. While measures of performance-related fitness are designed to evaluate a person's capability to carry out certain physical tasks or activities, the focus of health-related fitness testing is on the concurrent or future health status of the subject under assessment. (1)

MOBILITY has defined as an ability of an individual to initiate, control, or sustain active movements of the body to perform simple to complex motor skills. It relates to functional range of motion (ROM) and is associated with joint integrity as well as flexibility (2).

A sustained or intermittent external, end-range stretch force, applied with overpressure and by manual contact or a mechanical device, elongates a shortened muscle-tendon unit and periarticular connective tissues by moving a restricted joint just past the available ROM. If the patient is as relaxed as possible, it is called passive stretching. If the

patient assists in moving the joint through a greater range, it is called assisted stretching. Categories include, but are not limited to, manual and mechanical stretching or self-stretching as well as passive, assisted, or active stretching. (2)

A reduction in muscular flexibility not only reduces functional levels but also causes damage to the musculoskeletal system due to overuse. Such damage mainly occurs in multi-joint muscles which have a large functional excursion and a high percentage of fast-twitch muscle fibers, and the calf muscle has been reported to be the multi-joint muscle that is most frequently damaged in the human body.(3)

Stretching techniques are the treatments used to improve muscular extensibility to improve ROM, and can help prevent damage in daily life or sports, reduce muscle pain, and improve muscle capability, and athletic performance. (3)

Lack of flexibility has been suggested as a predisposing factor to calf strains. (21, 22) Worrell and Perrin (1992) proposed a theoretical model for calf strains, suggesting that they result from a complex interaction of four etiologic factors: warm-up, strength, fatigue, and flexibility. To prevent muscle injuries, stretching exercises before sports activities are usually recommended. Reasons for stretching relate to beliefs that stretching exercises will increase flexibility and decrease muscle stiffness. (4)

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Work-related musculoskeletal disorders (WMSDs) are responsible for morbidity in many working populations. Apart from lowering the quality of workers' life and reducing productivity, WMSDs are the most expensive form of work disability, attributing to about 40% of all costs toward the treatment of work-related injuries. WMSDs are considered to be multifactorial that are caused due to the interactions between various risk factors, which result in conditions that vary across different occupations. Although the health care profession is known to be at high risk for WMSDs, it is one of the least-studied occupations. Most of the previous studies on WMSDs among health care workers were limited to any one of the professional groups such as nurses, physical therapists, dentists, and others. Hence this study was aimed at looking into the WMSDs affecting physical therapists' health care professionals working in clinics. By providing mechanical stretching devices strenuous work activities load can be reduced. (5)

So, the need of the study is to design a flexibility device to stretch and cure tightness by providing mechanical stretching and decreasing the incidence of WRSDs physiotherapists.

Aim of the study:

To design a cost-effective, safe and effective flexibility device for calf muscle stretching for muscular tightness management.

Objectives of the Study:

- 1) To see the effect of the manual stretching technique on the flexibility of the calf muscle.
- 2) To see the effect of the mechanical stretching technique on the flexibility of the calf muscle.
- 3) To compare muscle flexibility before and after manual stretching technique and mechanical stretching technique.

Hypothesis

Null Hypothesis

There is no significant difference in the flexibility of calf muscles after manual and mechanical stretching techniques.

Experimental Hypothesis

There is a significant difference in the flexibility of calf muscles after manual and mechanical stretching techniques.

2. Literature Review

- 1) Chen-Yu Chen et al. (2022) evaluated Work-related musculoskeletal disorders (WMSD) among 8988 PTs (3302 males and 5696 females) physical therapists in Taiwan result states most common types of WMSD were soft tissue injury (66.99%), spinal disorders (59.1%), and sprains and strains (56.8%). In contrast, arthropathy (8.06%) and disorders of peripheral nerves (12.60%) were less common and the risk of WMSD among PTs was positively correlated to the frequency of patients seeking rehabilitation service. (6)
- 2) Jean E Cromie et al. (2000) did a study for Work-Related Musculoskeletal Disorders on a state register Physical Therapists (n = 824) were surveyed for

Prevalence, Severity, Risks, and Responses and concluded that Lifetime prevalence of WMSDs was 91%, and 1 in 6 physical therapists moved within or left the profession as a result of WMSDs. (7)

- 3) Amr Almaz Abdel-aziem et al. (2013) effect of standing, supine and dynamic position on hamstring flexibility for 75 subjects divided in 3 groups and concluded that there is significant improvement present in standing and supine position stretching for hamstring flexibility. (8)
- 4) Nor Azlin M. Nordin et al, 2011 Work-related injuries among physiotherapists in public hospitals a Southeast Asian picture and concluded that Work-related injuries are significantly higher among the physiotherapists in Malaysia compared with many other countries. (9)

3. Materials & Methods

Source of Data: Subjects has selected from various physiotherapy clinics.

Study Design: An Experimental study

Sampling Technique: Purposive sampling

Study Population: Subjects with muscular tightness

Sample Size: 30 subjects

Materials to be used:

- Assessment form
- Consent form
- Gonio meter
- Flexibility device
- Pen
- Paper
- Stopwatch
- Plinth
- Inch tape

Inclusion Criteria:

- Age group: 25 to 50 years of age
- Gender: Female and male
- Subject with positive flexibility test calf muscles.

Exclusion Criteria:

- Subject with a traumatic and non-traumatic musculoskeletal condition.
- Any cardio-pulmonary conditions and neurological conditions.
- Pregnant women
- Uncooperative subjects
- Subject with deformity
- Subject with surgical procedure
- During menstruation

Measurement Procedure:

The flexibility device has been designed with the help of a biomedical engineer. Patient Safety, cost-effectiveness, and treatment efficacy parameters have been taken into consideration for designing the device.

30 healthy subjects who fulfilled inclusion criteria were selected for the study. Oral consent was taken from subjects who fulfilled the inclusion criteria. Subjects were oriented and explained the whole procedure of the study.

Prior to the testing, Age, gender, and BMI were recorded. A flexibility test was performed for calf muscles in all subjects' prior intervention.

- Flexibility measurements:
- calf flexibility: standing lunge test

Subject with muscle tightness has been recruited for the study.

All subjects took passive manual stretching treatment for one leg. Calf muscle stretching was given for 3 repetitions for 30 sec. hold given. Again, a flexibility test was performed and post-treatment data was recorded.

Mechanical stretching treatment with the use of a flexibility device in another leg. Calf muscle stretching was given for 3 repetitions for 30 sec. hold given. Flexibility measurement was done after treatment. Differences in pre and post-data were recorded for the study.



Figure 1: Calf flexibility device



Figure 2: Calf stretching application



Figure 3: Calf muscle stretching with device use

Statistical Analysis

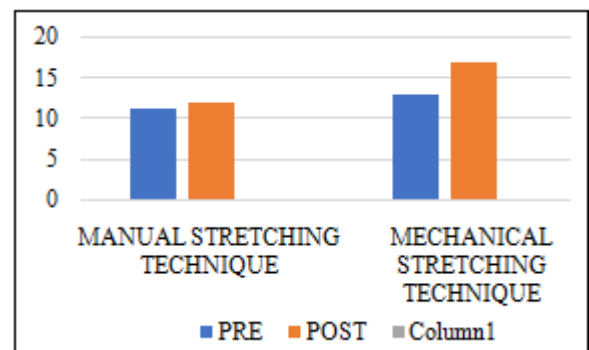
Statistical analysis has been done by SPSS's latest version. Paired t-test has been used.

4. Result

- There is a difference in the results of both techniques.
- P-value of the test is 0.066. Which is greater than 0.05 so, statistically insignificant.
- Difference is not statistically significant.
- So, mechanical stretching can be useful for calf muscle tightness treatment.

Table 1: Mean and standard deviation of both the treatment application with T value for 30 subjects.

Techniques	Standing Lunge Test (MEAN + SD)	Standing Lunge Test (MEAN + SD)	T value	P-value
Manual Stretching Technique	11.26 + 2	12.01 + 3.1	0.066	> 0.05
Mechanical Stretching Technique	13.01 + 1.4	17.05 + 5.4	0.049	> 0.05



Graph 1: Mean of both the techniques for STANDING LUNGE TEST

5. Discussion

Present study results show manual and mechanical stretching both are helpful for tightness of calf muscle. There is more improvement present in the mechanical stretching technique. But it is not statistical significance, which partially supports the experimental hypothesis.

Calf muscle injuries and tightness are the most common musculotendinous injuries in the lower extremity. The "lack of flexibility was the single most important characteristic of calf injuries in athletes.

Musculoskeletal disorders (MSDs) in the workplace have a huge impact, emerging as a growing problem in our modern societies. they represent the second largest cause of short-term or temporary work disability after the common cold. Work-related musculoskeletal disorders (WMSDs) are responsible for morbidity in many working populations and are known as an important occupational problem with increased compensation and health costs, reduced productivity, and lower quality of life. WMSDs are characterized as multifactorial.

As physiotherapy treatment includes massage and manual therapy which requires more strength of muscles. Continued loading activities lead to such pain among physical therapist.

The strength of individual therapists can be a barrier to treating patients. As Physical therapists need to treat an average of 5 patients a day in clinical setups. The efficacy of the therapist can be the reason to have less improvement in the manual stretching group of patients.

6. Conclusion

- 1) Flexibility device is helpful to treat tightness of calf muscle.
- 2) Work-Related Musculoskeletal Disorders (WRSDs) among physiotherapists can be managed by using this device.
- 3) As Load handling, especially when bending and twisting, Repetitive or forceful movements, awkward and static postures, Vibration, poor lighting, or cold working environments, Fast-paced work, and Prolonged sitting or standing in the same position can be required of physiotherapists while treating a patient in clinical setups.

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Ethical Approval: Approved

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