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Additional Effects of Tissue Flossing Coupled with Functional Activities on Hamstring Flexibility and Dynamic Balance in Recreationally Active Female Students: A Randomized Clinical Trial

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ABSTRACT

BACKGROUND: Hamstring tightness, generally defined as a lack of ROM with a concomitant feeling of restriction in the posterior thigh, has been documented across all age groups as a potential cause of dysfunctional or restricted movement of the hip. Hamstring flexibility is essential to avoid musculoskeletal problems of lower quadrant. Starrett and Cordoza, in 2015 stated that compression tissue flossing or tissue flossing is a new method and technique that is getting more and more popular to increase range of motion, reduce pain, prevent injury, improving muscle contractions in athletes and normal exercisers.
PURPOSE: To find out the additional effects of tissue flossing coupled with functional activities on hamstring flexibility and dynamic balance in recreationally active female students.
METHODS: After taking informed written consent, students were divided into 2 groups. Study was done on 52 female students; Group A was Experimental group and group B Control group. Experimental group received floss band along with functional actives and Control group received functional activities alone, all the functional activities were performed for 15 times and 3 times/week for 4 weeks. KEA and SLTH were used as outcome measures and pre and post-intervention measures were taken.
RESULTS: The results of this study showed statistically significant improvement in knee extension angle and dynamic balance with the use of floss band along with functional activities and functional activities alone (P value $\leq$ 0.001). But, in between group comparison, floss band along with functional activities were found to be more effective than functional activities alone (P value $\leq$0.05).
CONCLUSION: Flossband along with functional activities were found to be more effective than functional activities alone on hamstring flexibility and dynamic balance in recreationally active female students.

KEYWORDS: Tissue flossing, Floss band, Hamstring flexibility, Dynamic balance, Knee extension angle (KEA), Single leg triple hop test (SLTH)

INTRODUCTION

- The posterior compartment of the thigh is composed of three muscles generally referred to as the hamstring muscles. It contributes to the movement of the hip and the knee joints as they span across both the joints. This function provide these group of muscles essential to movement of standing, walking and running and therefore subsequently more vulnerable to injury.[1] Normal hamstring length will prevent excessive lumbar flexion during postures that place the hamstring muscles in a lengthened position such as forward bending. [2,3] Hamstring tightness, generally defined as a lack of ROM with a concomitant feeling of restriction in the posterior thigh, has been documented across all age groups as a potential cause of dysfunction or restricted movement of the hip.[4] Hamstring tightness is not only causative factor for reduced range of motion but it can also lead to various other musculoskeletal problems.[5]
- Prevalence of hamstring tightness is very high in college going students with age group of 18-25 years where 68% of students are affected. Hence, maintenance of initial muscle length requires regular stretching to avoid muscle tightness, reduce risk of musculoskeletal injuries and enhance muscle performance.[6,7]
- Flexibility, in comparison to muscular tightness, is a physiological concept in which joint excursion is represented by, although not synonymous with, range of motion (ROM) measures, and involves input from both joint and soft tissue structures e.g., nerves, muscles.[8] Good flexibility provides relaxation posture which eases muscular pain, helping in quick recovery, and reducing stress and keeping the body feel loose and agile.[9]
- Reduced flexibility of hamstrings may also have negative impacts on the function and biomechanics of the knee and hip joints and the lumbo-pelvic rhythm and cause dysfunction and postural abnormalities.[10]
- Balance refers to an individual's ability to maintain their center of gravity within their base of support. There are two types of balance; static balance which refers to the ability to maintain equilibrium when the individual is stationary and dynamic balance which is the ability of an object to balance while in motion or interchanging between positions. Good dynamic balance is essential for the effortless performance of the ADLs and self- care activities and also recreational activities.[10]
- Tissue flossing stimulates mechanoreceptors in the underlying fascial layers, leading to reperfusion of the compressed tissue (hence leading to enhanced blood flow), or causes fascial shearing, and consequently the fascia's sliding potential is restored.[11] It improves individual performance in increased range of motion, counter movement jump, rate of force development, increased torque, jump height, jump velocity, reduced muscle contraction time and perception of flexibility. In addition, the floss band, as an effective instrument has the same benefits as dynamic stretching in decreasing tightness of the hamstrinsg, or it is even more beneficial.[12]

MATERIALS & METHODS

- The study was conducted on 52 recreationally active female students after receiving ethical approval.
- Students were selected on the basis of purposive sampling and were divided into two groups: experimental group and control group. The three trials of knee extension angle (KEA) were assessed

bilaterally with 360 degree goniometer. The best of the three trials was recorded for analysis. The students were asked to complete three trials of a single leg triple hop (SLTH) test and the distance was assessed bilaterally. The best of the three trials was recorded for analysis.

Figure-1: Knee Extension Angle (KEA)

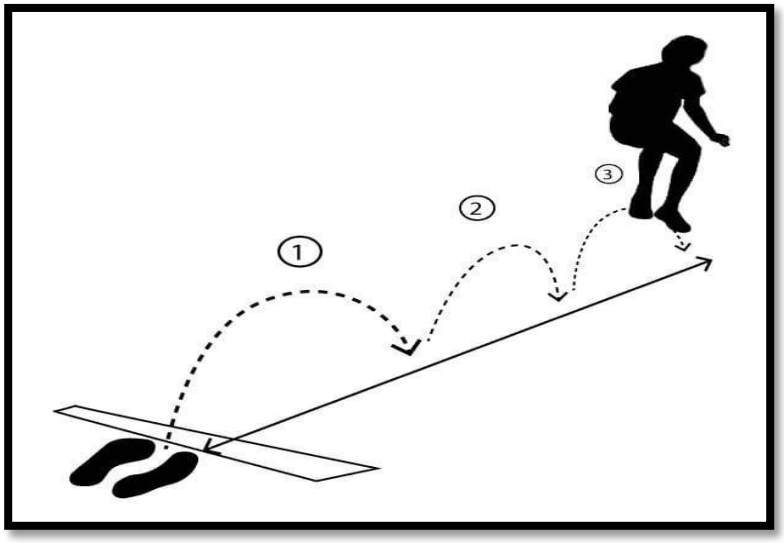


Figure-2: Single Leg Triple Hop Test (SLTH)

Experimental group received floss band along with functional activities (Squats, side lunges and knee hugs) and Control group received functional activities alone. Outcome measures were assessed pre and post interventions with KEA and SLTH.

Figure-3: Squat with floss band

Figure-4: Side lunge with floss band

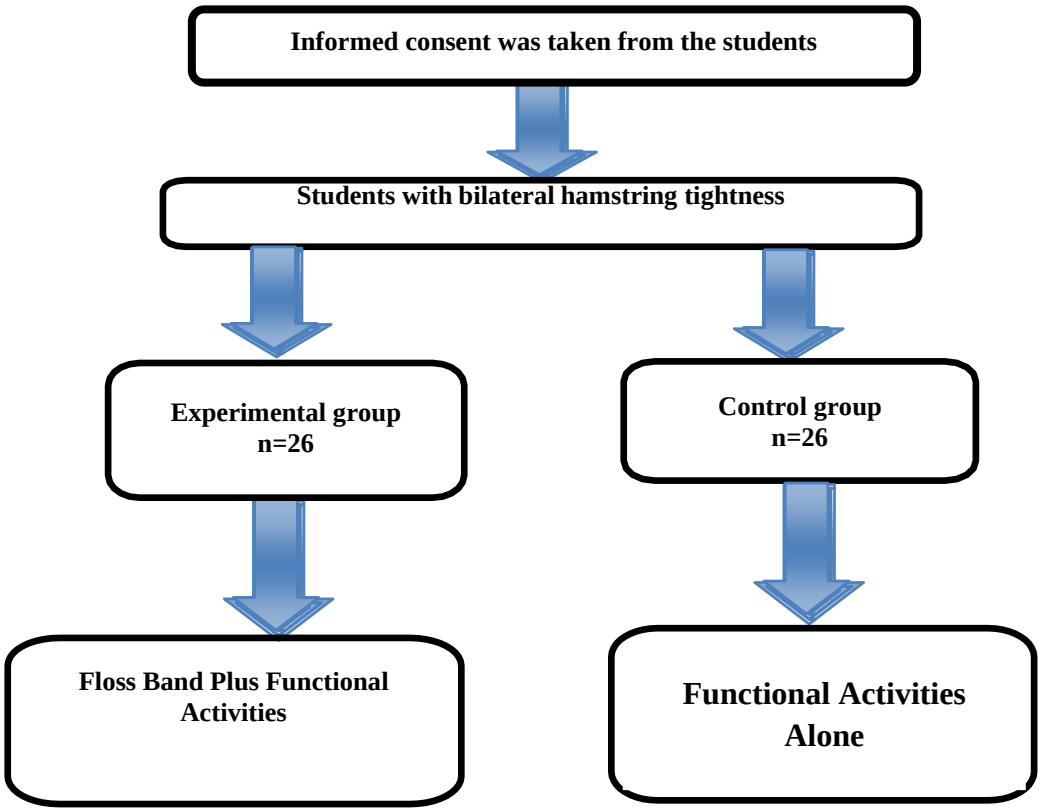
Figure-5: Knee hug with floss band

Figure-6: Squat without floss band

Figure-7: Side lunge without floss band

Figure-8: Knee hug without floss band

FLOWCHART OF PROCEDURE:



DATA ANALYSIS

Data was analysed by IBM SPSS 29.0 software and Microsoft Excel 2019. Prior to the statistical tests, data was screened for normal distribution by Shapiro-Wilk's test. Baseline characteristics were similar for both the groups. The data was normally distributed for all outcome measures. Within group and between group analysis of outcome measures were done after 4 weeks of completion of

intervention. Level of significance was kept at 5% and confidence interval of 95%. Parametric tests were applied for within group and between group analysis. Within group analysis was done using paired t-test and between group analysis was done using unpaired t-test.

RESULTS

In this study, a total of 52 students were recruited, 26 in each group.

Experimental group was treated with Floss band along with functional activities and Control group was treated with functional activities only. The descriptive characteristics of all variables were as follows:

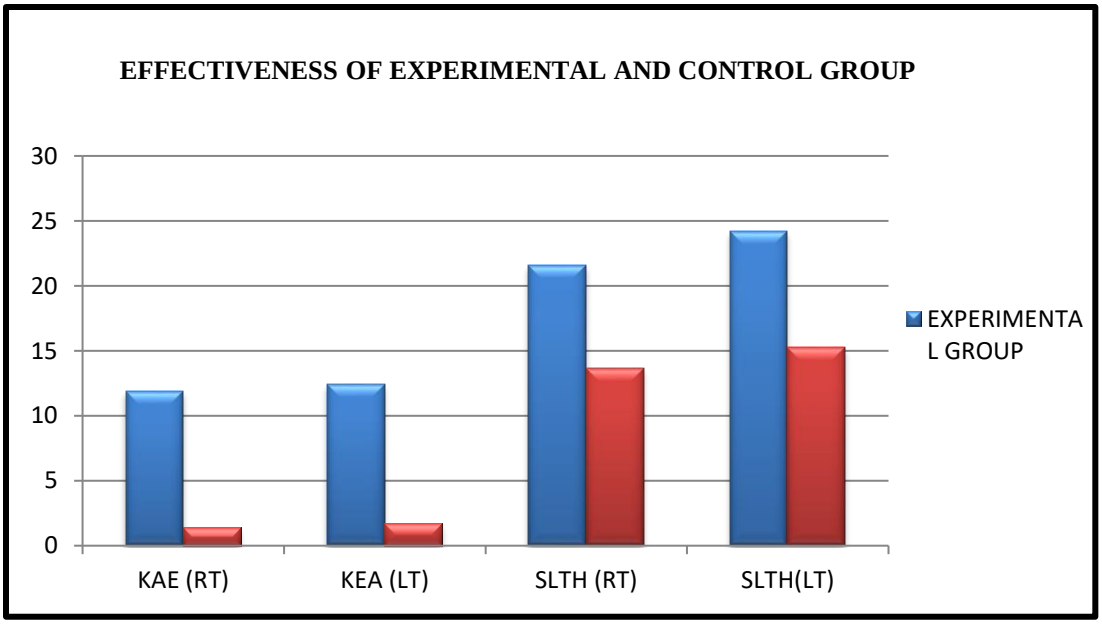
GROUPS	EXPERIMENTAL GROUP	CONTROL GROUP
NO. OF STUDENTS	26	26
	MEAN ± SD	MEAN ± SD
AGE	21.92 ± 1.89	22.15 ± 1.61

Table 1: Baseline Data

OUTCOME MEASURES	EXPERIMENTAL GROUP (MEAN ± SD)	CONTROL GROUP (MEAN ± SD)	P VALUE	REMARKS
KEA(Rt)	11.85± 3.44897	1.38± 1.44435	<0.001	Significant
KEA(Lt)	12.42± 3.95144	1.73± 1.92993	<0.001	Significant
SLTH (Rt)	21.58± 13.28811	13.65±11.99314	0.028	Significant
SLTH (Lt)	24.19± 17.6273	15.27± 12.61287	0.041	Significant

Table 2: Experimental and Control group (Between group analysis)

Graph-1: Intergroup analysis



Here, the difference of pre-intervention and post-intervention was taken and between group comparison of KEA (Rt), KEA (Lt), SLTH (Rt) and SLTH (Lt) showed statistically significant difference i.e. additional effects of treatment on both groups were not equally effective as shown in the graph-1

Hence, tissue flossing along with functional activities were found to be more effective in increasing hamstring flexibility and dynamic balance than functional activities alone.

DISCUSSION

Flossband, as a therapeutic intervention instrument, can be used to increase knee

ROM over the long period of time. The vast majority of the studies are showing a positive trend with significant range of motion improvement (Driller and Overmayer, 2017; Stevenson, Stevenson and Duarte, 2019; Galis and Cooper, 2020; Kaneda, Takahira, Tsuda, Tozaki, Kudo, et al., 2020; Vogrin et al., 2021).

As per the literature by Prill et al (Prill, Schulz and Michel, 2019), tissue compression flossing seems to have significant effect on reducing delayed onset muscle soreness when compared to the golden standard of treatment (stretching, massage, electrotherapy, sonography and pharmaceuticals).[13]

The primary aim of this study was to examine the additional effects of tissue flossing coupled with functional activities on hamstring flexibility and dynamic balance in recreationally active female students.

Kaneda H et al. (2020) also supported that flossband wrapping around hamstring muscle from above the knee significantly enhanced straight leg performance compared to the group without floss band. The mechanism behind muscle flexibility changes caused by floss band may be due to shear force during tissue flossing or the thermal effect during flossing.[11]

In general, there is evidence that a floss band treatment applied either on the joint or soft tissue is able to increase the flexibility of the related muscle. Moreover, joint flossing may additionally increase jump height, and flossing applied on the thigh can positively affect isometric strength. Gustav Gabrielson conducted a systematic review in 2021 suggesting that compression tissue flossing significantly increases range of motion, counter movement jump, rate of force development, increased torque, jump height, jump velocity, reduced muscle contraction time and perception of flexibility.[16]

The blood flow disruption is thought to jump start hormonal and catecholamine responses that could result in enhanced blood flow and muscle nutrition that improves ROM. It is plausible that due to the cascade of biological events that must occur during this mechanism that it may not result in immediate ROM effects.[16]

Szu-Ying Wu et al. in 2022 conducted a study on, "Effects of Tissue flossing Coupled with Functional Movements on Knee Range of Motion, Static Balance, in Single-Leg Hop Distance, and Landing Stabilization Performance in Female College Students." 20 active female (aged 19-23 years) students without musculoskeletal disorders were randomly assigned to receive a FLOSS intervention and Elastic Bandage (EB) control on dominant knees. The participants underwent FLOSS and EB activities on two occasions with 48 hours of rest between both sets of activities. Primary outcome was muscle flexibility which was measured using Ely's test and popliteal angle. Secondary outcome measures were time spent sustaining a single leg stance, distance on the single leg triple-hop test, and landing stabilization performance. The findings of the study indicated that the use of FLOSS combined with functional movements in female college students improved hamstring flexibility and landing stabilization.[17]

Floss band may be used to reduce muscle tightness, thus, flossband can be a potentially therapeutic tool for injury prevention and rehabilitation of the skeletal muscular fascial system disease. Applying flossband on the hamstring significantly changed its function, especially hamstring flexibility.[18] There were only two studies on muscle flexibility changes after applying flossband on soft tissues. Clinical implication of compression tissue flossing is to use as the treatment technique in decreased ROM and to improve neuromuscular function and sports performance. It is therefore recommended to use tissue flossing in warm-ups and rehabilitation in recreational and elite athletes who wants to improve their performance.

Limitations

The study was limited to healthy recreationally active female population.

An absence of diversion population, variety of population demographics, and body regions inhibited a consensus for application beyond the thigh and into pathological population.

An absence of long-term effects also inhibited the understanding of the length of treatment with successful clinical improvement.

No electrical modalities were used in the study for improving hamstring flexibility.

CONCLUSION

The results of this study supported the alternative hypothesis and showed statistically significant improvement in knee extension angle test and single leg triple hop test with the use of floss band along with functional activities and functional activities alone (within group comparison). But, in between group comparison, flossband along with functional activities were found to be more effective than functional activities alone. All findings support the idea and concluded that flossband along with functional activities were found to be more effective than functional activities alone.

Future Recommendations

In the future, more studies regarding the effects of flossband on skeletal myofascial system and its physiological mechanism needs to be conducted. There is a possible mechanism for the changes in the hip ROM which is likely due to increased stretch tolerance rather than changes in the mechanical parameters of the muscle. All in all, there is a recommendation to conduct long term studies regarding the effects of flossing treatment on various parameters like range of motion or performance and their mechanism.

Declaration by Authors

Ethical Approval: Approved

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Conflict of Interest: The authors declare no conflict of interest.

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