

## Ability of MRI Diagnostic Value to Detect the Evidence of Physiotherapy Outcome Measurements in Dealing with Calf Muscles Tearing

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### ABSTRACT

**Background:** Calf muscle tearing is one of the most sudden pain that affects the calf, foot, or thigh area. It can be diagnosed through Magnetic Resonance Imaging (MRI) and treated through physiotherapy interventions. The aim of the current study is to evaluate and assess the efficiency of physiotherapy interventions using Myofascial release and Stretching exercises in calf muscle treatment, and verification this effectiveness by traditional physiotherapy measurement tools and MRI.

**Methods:** The study included 30 patients with at least one degree tearing of the calf muscles. All patients were undergoing leg MRI imaging using a 1.5 Tesla MRI. The Visual analogue scales (VAS) and Functional disability scale for ankle (FADI) were assessed before the patients were offered therapies. Then the patients were randomly distributed into two groups: the first group was 15 patients who were given Myofascial release treatment, while the second group was 15 patients who were given treatment using Stretching exercises. After treatment, the efficacy of treatment was checked for patients by different tools: VAS, FADI, and MR imaging. Patients' outcomes before and after treatment were compared.

**Results:** The results showed that both Myofascial release and Stretching exercises had the same effect on patients. Comparison between pre- and post-score within groups for VAS, FADI, and MRI findings. Whereas, all P value values were less than 0.05 for all samples. When comparing the techniques presented for treatment between the two groups, the results showed that there were no differences between the two techniques in each of the VAS, FADI, and MRI findings, where the P-values post-treatment were 0.644, 0.112, and 0.831, respectively.

**Conclusion:** Myofascial release and Stretching exercises can be used to treat calf muscle tears in the sub-acute stages.

### Keywords

VAS, FADI, MRI, Calf muscle tears, Myofascial release, Stretching exercises.

### Introduction

Calf spasm is common among people, resulting from a sudden movement that pressures the Calf muscle. Therefore, muscle may stretch, strain, and tear to more than its normal limit. It is also possible for this spasm to occur over time, usually in people who practice running, playing tennis, and skiing, and in people

who routinely climb stairs [1]. A calf injury results from any tear, strain, or stretching of the calf muscles, and the recovery period from this injury is determined by the level of the injury itself. Calf muscle tears affect any part of the leg, including the thigh, calf, and foot [2].

Calf muscle tearing can be detected through medical imaging, which includes Computed tomography (CT) [3], ultrasound (US), and magnetic resonance imaging (MRI) [4] and also sing a Thompson Test [5,6]. CT is limited in detecting this spasm and

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tears because of the image quality limitation in soft tissue, while US imaging can be benefited from being relatively inexpensive and nonionizing imaging, but the doctor must be very familiar with a disorder of the normal fiber arrangement at the muscle-tendon junction, hematoma, and fluid accumulation between the calf muscle and the soleus muscle. US imaging can be used to monitor the healing of spasticity [7].

MRI is considered the best modality among the imaging methods for detecting soft tissues, and its imaging is considered harmless to the patient because it is within the non-ionizing radiation modalities. MRI can detect rupture or discontinuity of muscle fibers and retraction of the torn muscle fibers and detect the differences between gastrocnemius and Achilles' tendon injury. Recent studies encourage the use of MRI in the imaging of calf muscle problems [8-13]. Calf muscle tear is shown in MRI at four grades: Grade 0, muscle has edema and fluid in the near region of tendon or aponeurosis without myofibril detachment. Grade 1 there is myofibril detachment without any change in tendon or aponeurosis. Grade 2 there is myofibril detachment with adjacent tendon or aponeurosis with increased MRI signal but without retraction. Grade 3 there is myofibril detachment with adjacent tendon or aponeurosis with retraction failure [12,14,15].

In Thompson Test, the patient lies prone and his foot over the end of the table (knee flexed to 90), first the physiotherapy squeezes the calf muscles, specifically the gastrocnemius- soleus complex, with his hand. Squeezing the calf should cause contraction of the Achilles tendon, resulting in plantar flexion. If the Achilles tendon is completely ruptured, there will not be any apparent plantar flexion [6,16].

Calf muscle injury can be treated with physical therapy using several different techniques, including Stretching and Myofascial release. Myofascial release uses directed mechanical forces to reduce myofascial restrictions from various bodily imbalances. Myofascial release relief of pain to reduce tissue tenderness immediately after application [17,18]. This technology reduces edema and inflammation, improves recovery levels after trauma, improves range of motion, and reduces the use of pain relievers in patients with calf muscle tear [19,20].

Stretching is important in improving the range of motion by stretching the calf muscles [21]. When the muscle is stretched, the force of the stretch is transmitted to the muscle fibers through the connective tissue in and around the fibers. When the initial stretching occurs in the sequential elastic component, the tension rises sharply. After that, a mechanical defect occurs in the cross bridges as the filaments slip apart resulting in a sudden lengthening of the sarcomere known as sarcomere giving. When the stretching force is released, the individual sarcomere returns to the rest length [22].

Various treatments are provided for these problems, including providing physiotherapy for patients with muscle strain. The efficacy of physical therapy is confirmed using some scales, including Visual Analogue Scale (VAS) [18], and Foot and Ankle Disability Index (FADI) [23].

The treatment scales can confirm the efficacy of physical therapy in treating disease. However, the positive change in the patient through these techniques gives a slight change in the treatment of the patient and the possibility of returning to the optimal use of the affected muscle. Therefore, the aim of the current study lies in verifying the efficacy of Stretching and Myofascial release techniques on the patient with calf muscle tear by using MRI examination before and after giving the physiotherapy sessions to the patients with a calf muscle tear and comparing MRI results with physiotherapy measurement scale results.

## Methods

### Participants

A prospective longitudinal experimental study was carried out in Ibn-Rushed Radiology Center and AL Mahmoud physiotherapy center in Hebron, West Bank from December 2021 to March 2022.

A total of 50 patients with calf muscle strain were diagnosed by clinical examination based on Thompson Test. After that, the first MRI image was acquired to them (Pre-treatment). The MRI images showed only 30 people suffered from one grade at least of tearing of the calf muscles, and the rest were normal. Patient images were evaluated by three experienced musculoskeletal radiologists meeting the criteria by consensus. All images were done at Ibn-Rushed Radiology Center. After defining the study sample, the 30 patients were randomly divided into two groups: the first group was treated using myofascial release techniques, while the second group was given stretching exercises by a physical therapy physicist with 10 years of experience in his field. All physiotherapy sessions were provided at AL Mahmoud physiotherapy center.

The physical therapy techniques offered to both groups were assessed through the Visual Analogue Scale (VAS), and Foot and Ankle Disability Index (FADI). After completing the physiotherapy sessions, patients underwent MRI imaging again to verify the efficacy of the treatment provided to them (Post-treatment). Both Pre and Post-treatment images have the same parameters used. The results were compared for different examinations VAS, FADI, and MRI before and after the treatment of patients.

The study included patients between the ages of 20-40 years who were suspected of having a calf muscle strain through the Thompson Test, and who underwent MRI before and after their physical therapy. Also, the study included patients with a minimum of one grade of tear of the calf muscle. All male and female patients with calf muscle strain with Pain of at least 3 according to VAS were included in the study.

The study excluded all patients who had a Thompson test is positive, and they did not show any grade of tearing in the MRI images. Alternatively, those who have been imaged only once by MRI (Pre-treatment only). The study also excluded all patients with Achilles tendon tear, Bone disease, Any history of Anterior cruciate ligament (ACL) or Posterior cruciate ligament (PCL) surgery, Osteoarthritis, and Rheumatoid disease (RD).

## Protocol

After selecting the samples that followed the Inclusion criteria, the patients were randomly divided into two groups, and a different treatment was given to each group. The first group included 15 patients who underwent myofascial release technician treatment, later called Group A. The patient in this group were given 3 sessions per week for 2 weeks, 2 myofascial release technician was applied for 10 minutes, 5 minutes for every technique were applied.

The second group included 15 patients who underwent Stretch exercise, later called Group B. The patient in this group were given 3 sessions per week for 2 weeks, 4 Stretch exercise (Calf wall stretch (back knee straight), Bilateral calf stretches (knees straight), Ankle plantarflexion / Dorsiflexion, Bilateral heel raises on step) was applied for 20 minutes, 5 minutes for every technique were applied, repeated for 8 to 10 times.

The study samples were evaluated through three study-specific Outcome measurements. The assessment procedure included the following:

The MRI imaging technique included placing an external marker over the area of maximum symptom, as indicated by the patient. All scans were carried out using 1.5T MRI scanners. A dedicated surface coil was used to obtain a high-resolution image with 2.5 mm axial proton density (PD) and PD fat-saturated axial images, as well as 2 mm sagittal and coronal PD fat-saturated images.

Visual analogue scales (VAS): s a scale is used to determine the pain intensity experienced by individuals. It is a scale that measures the intensity of pain in patients, its length is 100 mm and it is called two horizontal and vertical lines (0 = without pain, 100 = severe pain) and it is a reliable and reliable measure. The mechanism of the scale work where the patient is asked to select the point that corresponds to the intensity of the pain he feels [18].

Functional disability scale for ankle (FADI): it is a region-specific self-report of function, firstly described in 1999 by Martin et al. Each of the 34 items is scored on a 5-point Likert scale from 0 (unable to do) to 4 (no difficulty at all). The 4 pain items of the FADI are scored 0 (none) to 4 (unbearable). The FADI has a total point value of 104 points, whereas the FADI Sport has a total point value of 32 points. The FADI and FADI Sport are scored separately as percentages, with 100% representing no dysfunction [24].

## Statistical Analysis

The SPSS 23.0 software (Statistical Package for Social Sciences) will use to study the difference in groups and within groups. Descriptive and frequency statistics will use to study the main characteristic of the sample. Means, standard deviation, and percentages. Continuous variables will give as mean  $\pm$  standard deviation while categorical variables will give as number and percentage. Independent samples t-test (or independent t-test for short) was used to study the similarity of demographic data between groups. Wilcoxon Signed Ranks Test was used to study

the change between pre- and post-diagnosis. Mann-Whitney Test was used to compare pre and post treatment scores between groups.

All participants have to assign a consent form, prior to being enrolled in the study. The consent form will be written in the Arabic language to be understood easily by all participants. The form will contain all details of the study. The consent form also will inform all participants that the results could be used in publications. All participants have the right to withdraw at any time they want. The researcher will take full responsibility for protecting the right safety and kept all private information of the participants.

## Results

Thirty participated in patients with calf muscle tension, which have at least one grade tearing, were included in the study. The participants were 40% males and 60% females. The age group distributed into 40 % between 21-24 years, 40 % between 25-29 years, and 20% more than 30 years old.

Most of the patients have a grade 2 calf muscle tear with 46.6%, and the other participants shared the grade 1 and grade 3 with same percentage 26.6%. Participants were distributed in a single blind method where the first group A (Myofascial release technique) and the second group B (stretching exercise) contained 4 patients with grade 1 Calf muscle tear, 7 patients with grade 2 Calf muscle tear, and 4 patients with grade 3 Calf muscle tear.

**Table 1:** Demographic data of the sample.

Variables	Number	Valid percent
<b>Gender</b>		
Male	12	40.0
Female	18	60.0
<b>Age</b>		
21-24	12	40.0
25-29	12	40.0
30 and above	6	20.0
<b>Grading of Calf Muscle tear on MRI</b>		
Grade 0	0	0.00
Grade 1	Group A	4
	Group B	4
Grade 2	Group A	7
	Group B	7
Grade 3	Group A	4
	Group B	4

Table 2 shows the comparison between pre- and post-score within groups for VAS, FADI, and MRI findings. In VAS, the myofascial release technique and stretching exercise decrease pain significantly, where the P-value for both techniques was 0.001. Both techniques improve function of ankle joint where the P-value in FADI was  $0.001 < 0.05$ . It mains myofascial technique and stretching exercise improve the function of a Talocrural joint. However, the stretching exercise have more effecting on both VAS and FADI comparing to myofascial technique where the mean changing from 7.40 to 2.50 and from 62.8 to 75.4, respectively. While the myofascial technique changing the mean from 6.9 to 2.24 in VAS and 69.8 to 73.2 in FADI.

The previous results were confirmed by MRI findings, where the table 2 shows the p-value in the Myofascial release technique was 0.016 while P-value in Stretching exercise was 0.004. This gives the impression that the Stretching exercise was better in treatment than the Myofascial release technique.

**Table 2:** Comparison between pre- and post-score within groups for VAS, FADI, and MRI findings.

		Pre - treatment	Post-treatment	P value
		Mean ± SD	Mean ± SD	
VAS	A (Myofascial release technique)	6.90 ± 1.14	2.24 ± 1.10	0.001
	B (stretching exercise)	7.40 ± 1.14	2.50 ± 0.50	0.001
FADI	A (Myofascial release technique)	73.2 ± 7.62	69.8 ± 1.09	0.001
	B (Stretching exercise)	75.40 ± 2.85	62.80 ± 2.40	0.001
MRI findings	A (Myofascial release technique)	2.00 ± 0.75	1.20 ± 0.94	0.016
	B (Stretching exercise)	2.00 ± 0.75	1.13 ± 0.74	0.004

VAS: Visual analog scale, SD: Standard deviation, FADI: Functional disability scale for ankle, MRI: Magnetic Resonance Imaging.

Mann-Whitney test was used to examine the pre and post results between both groups. Table 3 shows Pre-treatment scores revealed the P-value was 0.112, which means there is no statically significant difference between the both groups in FADI scores before the treatment. However, the test on the post-treatment scores shows that the P-value was 0.116, which means is not a statistically significant difference between group A and group B in FADI scores after the treatment.

**Table 3:** Comparison between pre- and post for both VAS and FADI scores between groups.

Group		Pre-treatment	Post- treatment
		Mean ± SD	Mean ± SD
VAS	A (Myofascial release technique)	6.90 ± 1.14	2.24 ± 1.10
	B (stretching exercise)	7.40 ± 1.14	2.50 ± 0.50
	P value between Groups	0.508	0.644
FADI	A (Myofascial release technique)	73.2 ± 1.09	69.8 ± 7.62
	B (Stretching exercise)	75.40 ± 2.40	62.80 ± 2.85
	P value between groups	0.116	0.112

VAS: Visual analog scale, SD: Standard deviation, FADI: Functional disability scale for ankle.

Table 4 shows the differences between the two groups of treatments which provided to patients. As it becomes clear that the two groups have no differences between them in the calf muscle tearing treatment, as the P-value equals to 0.831. This supports the results obtained in Table 3.

**Table 4:** Comparison between pre- and post-treatment between groups according to MRI findings.

Group	Number	Mean	Std. Deviation	DF	T	Sig
Myofascial release	15	1.20	0.94	28	0.215	0.831
Stretching exercises	15	1.13	0.74			

## Discussion

The current study was performed to compare the effect of stretching exercise and myofascial release technique on pain and ankle joint function in patients with calf muscle tearing. Our results indicated stretching exercises and myofascial release technique reduce pain and improve FADI for patients with calf muscle tear. Stretching exercise more effective than myofascial release technique in both outcome measurements.

Myofascial release rearranges the collagen fibers, and may improve the sliding of actin and myosin during contraction. Thus, after Myofascial release for the calf muscle, subjects may find contraction of the muscle easier, thus decreasing contraction time. In Kurume and colleagues reported that effects of myofascial release and stretching technique on range of motion and reaction time. The study results found that Myofascial release improves not only range of motion, but also ease of movement [25]. Another study conducted by Vijayakumar and friends reported that effectiveness of compressive myofascial release vs. instrument assisted soft tissue mobilization in subjects with active trigger points of the calf muscle limiting ankle dorsiflexion. They found both compressive myofascial release and instrument assisted soft tissue mobilization were useful interventions for reducing pain as well as improving ROM and also had a good 24-hour carry-over effect [26].

Stretching muscles helps increase venous and lymphatic flow moving the excess fluid away from the body tissue. In Hallegraef and colleagues reported that stretching before sleep reduces the frequency and severity of nocturnal leg cramps in older adults. As results, the frequency of nocturnal leg cramps decreased significantly more in the experimental group and it showed that six weeks of nightly stretching of the calf and hamstring muscles significantly reduced the frequency and severity of nocturnal leg cramps in older people. The best estimate of the average effect of stretching on the frequency of cramps was a reduction of about one cramp per night [27].

Tanna Monali her study was about a comparative study between effects of stretching vs. effects of cryotherapy and stretching for calf cramps in antenatal women. As findings, this study implies that cryotherapy with stretching is more effective clinically however the difference is not statistically significant, so both the treatments should be considered effective [28].

Wilke and colleagues in their study, immediate effects of self-myofascial release on latent trigger point sensitivity. As this study finding, Static self-myofascial release using a foam roller might represent an alternative to reduce pressure pain of latent MTrP. Additional research should aim to extend these findings to patients and athletes with myofascial pain syndromes [29].

Myofascial release technique and stretching exercises according to pathophysiology, it decreases oedema, because myofascial release can decrease the inflammation, this pain amplification causes to the nervous system by working to relieve these restrictions

through these gentle techniques. The body can release this tension and decrease a person's overall pain and also stretching exercises help increase venous and lymphatic flow moving the excess fluid away from the body tissue, for these reasons both of technique have advantage for decreasing oedema. Therefore, the MRI signal shows decreasing in intensity, and that make sure that both techniques can improve the patient health condition, and they can use to treat calf muscle tearing tendons [30].

Our strength in this study is that calf muscle spasm is a common condition, and common of research on this subject, and using MRI as an assessment tools in physiotherapy techniques treatment. The weakest point in our study was that weak communication between the participation due to covid-19 pandemic, the sample is not representative.

### Conclusion

The current study was concluded that the stretching exercises and myofascial release technique have a positive effect for reducing pain and improve function in the ankle joint. Moreover, the study findings were indicated that stretching exercises was more effective than myofascial release technique in VAS and FADI. This improvement by using MRI as a third tool for assessment physiotherapy outcome measures.

### Disclosure

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