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Original Research Article

Effectiveness of Compressive Myofascial Release Vs Instrument Assisted Soft Tissue Mobilization in Subjects with Active Trigger Points of the Calf Muscle Limiting Ankle Dorsiflexion

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ABSTRACT

Objective: To study the effectiveness of Compressive Myofascial Release (CMR) and Instrument Assisted Soft Tissue Mobilization (IASTM) on pain and ankle dorsiflexion (ADF) ROM and to obtain patient feedback associated with receiving either or both treatment approaches.
Design: Experimental study.
Participants: Consecutive sample of 33 active adults (48 limbs) with an active trigger point (TrP) of the calf muscle and limited ADF ROM was done over a period of 5 months.
Method: Qualifying limbs were assigned to 3 groups using alternate allocation. Group A received ischaemic compression for the active TrP followed by CMR, group B received TrP release using JT tool followed by IASTM treatment and control group C received warm-up followed by stretching and icing. Pre-treatment, immediate-post and 24-hours post outcome measures were recorded. The subjects were presented with a feedback questionnaire during reassessment post 24 hours.
Outcome measures: Visual Analogue Scale(VAS), Pressure Algometry, ADF ROM.
Results: Both groups A and B showed highly significant results wherein CMR played a slightly more significant role in improving ADF ROM whereas, IASTM proved to be slightly more significant in alleviating pain. Subjective pain measures significantly reduced when compared between three groups ($p \leq .00002$); similarly, objective pain outcome compared between three groups was also highly significant ($p \leq .00002$).
Conclusion: Both CMR and IASTM were useful interventions for reducing pain as well as improving ADF ROM and also had a good 24-hour carry-over effect. When patient opinion was concluded, IASTM had an upper hand in terms of patient comfort and better tolerance to treatment.
Key words: Compressive Myofascial Release (CMR), Instrument Assisted Soft Tissue Mobilization (IASTM), pressure algometry, active trigger points, ankle dorsiflexion ROM.

INTRODUCTION

The myofascial system being a complex network of muscles and related fascia aids in force transmission of muscles, fibroblastic activity, proprioception, nociception, and reducing compartmental friction during movement through sliding of fascial layers. Restriction within the myofascial system may occur due to injury, poor posture, or lack of full range of motion. [1]

Loss of joint range of motion is common and may be a precursor to musculoskeletal injury. A lack of Ankle Dorsiflexion (ADF) ROM increases the likelihood of a variety of lower extremity injuries affecting the foot and ankle and the posterior chain as a whole. Having less than 20^0 of closed chain dorsiflexion impedes normal gait and may cause compensatory gait patterns. [2] A lack of ankle DF can predispose a healthy individual to conditions such as genu recurvatum, excessive subtalar joint pronation, metatarsalgia, ankle sprains, shin splints, Achilles tendinopathy, plantar fasciitis, anterior knee pain, gastrocnemius strains and anterior cruciate ligament injuries. [2]

Literature suggests that myofascial trigger points (MTrPs) may cause restricted joint ROM (Travell and Simons, 1983; 1992; Simons et al, 1999; Lucas et al., 2004; Fernandez de las Penas et al., 2005; Blanco et al., 2006), there is lack of research suggesting that TrP release may be an effective intervention for restriction in joint ROM. It has been previously studied that soleus TrPs release has an immediate significant increase in ADF ROM. [3] One of the most common cause for limited ADF is gastrocnemius muscle tightness. [3,4] A trigger point is a hyperirritable spot located in a palpable, taut band of muscle fibres. It is always tender, prevents full lengthening of muscle, weakens the muscle, mediates a local twitch response of muscle fibres when adequately stimulated and when compressed within the patient’s pain tolerance, produces referred motor phenomena (active MTrPs) and often autonomic phenomena (Travell and Simons, 1983; 1992; Simons et al, 1999). Trigger points form from an excessive release of acetylcholine which produces sustained depolarization of muscle fibres. Sarcomere length is reduced and width is increased. These sustained contractions of muscle sarcomeres compress local blood supply restricting the energy needs of the local region. This crisis of energy produces sensitizing substances that interact with some nociceptive nerves traversing in local region which in turn can produce localized pain within the muscle. [5]

Myofascial trigger points (TPs) in the superficial two joint gastrocnemius muscle are usually found along either the medial or lateral border of the muscle. These TPs commonly refer pain over the calf and to the instep of the foot. Active TPs in this muscle make walking uphill painful and commonly cause nocturnal calf cramps. TPs in the second layer, single joint soleus muscle frequently are the cause of heel pain and tenderness that is mistakenly attributed to a heel spur. Occasionally, TPs in this muscle project pain to the area of sacroiliac joint of the same side. [6]

Two most common forms of soft tissue mobilization techniques are compressive myofascial release (CMR) and instrument assisted soft tissue mobilization (IASTM). [2]

CMR is a type of soft tissue stretching that involves applying compression and sustained myofascial stretches to the target area to produce release. [2] Ischaemic compression using local application of sustained pressure over the MTrP has been reported to reduce muscle spasm and therefore deactivates the MTrP. It is also thought that the deep pressure results in release of endorphins which masks the perception of pain. [7]

IASTM is based upon the rationale introduced by James Cyriax. IASTM uses specially designed instruments to identify and treat myofascial restrictions and provide mobilizing effect to the soft tissue to decrease pain and improve range of motion. The use of IASTM is to provide a mechanical advantage for the clinician by allowing deeper penetration, while also reducing imposed stress on hands. [1] The IASTM treatment is thought to stimulate connective tissue remodeling through resorption of excessive fibrosis, along with inducing repair and regeneration of collagen secondary to fibroblast recruitment. [7,8]

Both techniques use similar principles aimed at localizing and treating specific areas of restriction within the fascial system and are intended to release scar tissue, treat fascial adhesions, or reduce tightness within the musculotendinous unit.[2] However, very few have compared the two techniques in terms of effect on pain, improving functional limitations and patient comfort.

The primary aim of this study is to analyze the probable outcomes of these manual therapy interventions, in a single session of CMR vs IASTM on treating active TPs and restricted myofascia of the calf muscle restricting ankle dorsiflexion ROM. The secondary aim is to obtain patient feedback on the treatment perceived and better appreciated by the patient.

MATERIALS AND METHODS

Study was conducted after approval from the institutional ethical sub-committee. Eligible participants read and signed an informed consent prior to enrolment in this study. The study utilized an experimental study design.

PARTICIPANTS

Subjects of either gender with spontaneous complaint of calf pain were assessed for at least one active trigger point in the calf Muscle with referred pain to the pain reference zones along with a restricted ankle ROM of the homolateral lower limb. Initial screening indicated a 37% prevalence of subjects presenting with active TPs of the calf muscle limiting ankle dorsiflexion among participants with calf pain. Accordingly the sample size was calculated to be 48. Subjects with more than one active TrP in the calf Muscle were excluded from the study to prevent patient to patient bias. Subjects with acute injury to the involved lower extremity and patients who have undergone recent surgical procedure on the involved lower extremity were also excluded from the study.

A consecutive sample of 33 physically active adults (48 limbs) who fulfilled the inclusion criteria was taken and alternately allocated to one of the three groups: CMR group, IASTM group, or control group.

INSTRUMENTS

The IASTM treatment was applied using a medical grade stainless steel myofascial release. Similarly, a JT tool was utilized for trigger point pressure release In the IASTM group.

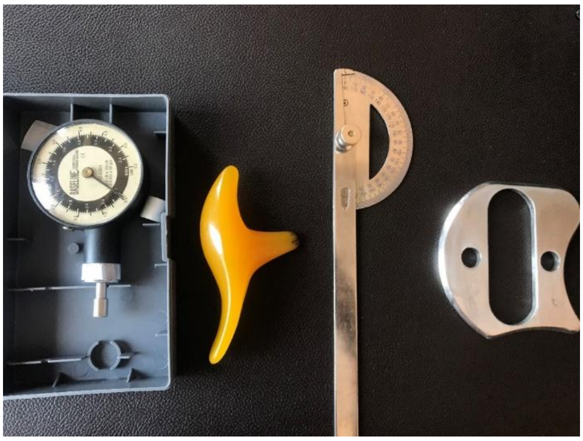

Figure 1: Instruments used in the study.

PROCEDURE

The subjects with spontaneous calf pain were assessed.

The procedure was explained and an interviewing screening Performa was implicated to the subjects in which their demographic data, presenting history, past surgical history was asked followed by assessment for presence of an active TrP in the calf muscle and severity of pain on VAS (visual analogue scale).

The criteria to establish the presence of an active trigger point include localized tenderness, a taut palpable band in muscle concerned, presence of hypersensitive spot in the taut band, typical referred pain pattern of active trigger points in response to compression, limited stretch range of muscle concerned, local twitch response elicited by snapping palpation of taut band.

Subjects fulfilling the above criteria presenting an active trigger point and one or more latent trigger points in the calf were carried forward for further study. Patients with more than one active TrP were excluded from the study to prevent patient to patient bias and error while comparing the outcome.

This was followed by local examination including range of motion evaluation (In open chain). Open chain ankle dorsiflexion ROM was measured with the help of a goniometer; patient in supine position, knee extended at 0^0 and ankle in neutral position. The patient was asked to dorsiflex actively and any measurements less than 200 of active DF were considered as an eligible sample for study.

The eligible subjects were examined for subjective pain using VAS on a 10 cm scale in which 0 indicated no pain and 10 indicated maximum pain. 3 scales each were provided each for pre-treatment, immediate post-treatment and 24 hours post-treatment respectively. Patient marked on each scale without having seen the markings on the previous scales.

The trigger point Pain Pressure Threshold (PPT) was measured with the help of a pressure algometer as an objective pain measurement, pre-treatment, immediate post-treatment and 24 hours post-treatment.

Ankle dorsiflexion was examined likewise using a goniometer, pre-treatment, immediate post-treatment and 24 hours post-treatment respectively.

Each measurement for subjective and objective pain as well as ROM was taken thrice, and its mean was used for further analysis to ensure accuracy.

Participants in the group A, CMR group were instructed to lie prone with their feet off the end of table. All pre-treatment outcomes were measured as per protocol. Treatment commenced with ischaemic compression to inactivate the active TrP with 3 cycles of 30 seconds each followed by broad strokes applied with the clinician's knuckles to release areas of restriction of the calf muscle for a period of 4-7 minutes. Participants in the group B, IASTM group were instructed to lie prone with their feet off the end of table. Ischemic compression was applied with the help of JT tool to inactivate the trigger point in a similar fashion 3x30 seconds. Small amount of emollient was applied to the calf muscle. The clinician began with scanning the muscle using sweep strokes to identify areas of restriction. Areas of restriction were treated with the IASTM tool 30-60 seconds per lesion.

The control group C was given conventional treatment. The intervention consisted of warm-up which included toe raises 15*3 sets, followed by calf passive stretching with the patient in supine; 3 reps with 30 second holds. Subjects received icing at the end of intervention as a conventional measure.

All outcome measurements including pain on VAS, pressure algometry and ROM were completed three times each, pre-treatment, immediate post-treatment and 4-hour post treatment. The averages of three measurements were used for analysis.

The subjects were presented with a questionnaire to provide feedback about the treatment received at the time of reassessment post 24 hours of treatment.

STATISTICAL ANALYSIS

The study was conclusive of 48 eligible samples with active calf TrP limiting ankle dorsiflexion under three different intervention groups with 16 samples each. Three outcome measures ankle dorsiflexion ROM, pressure algometry and VAS were used to examine the subjects at pre-intervention, immediate post intervention and 24h post intervention. The ROM and subjective and objective pain for pre, post and 24h post values were calculated for all three groups and were found to be normally distributed. Hence, met the criteria for parametric testing. The scores were analysed using ANOVA two-factor with replication as more than two groups and outcome measures were involved, to determine the variance between groups and hence comparing the effectiveness of each technique.

RESULTS

Active TrP of the calf muscle limiting ADF ROM was found to be more prevalent in the age group of 20-24 which consisted of 35 samples i.e 73% of the sample population. It was seen that 65% subjects who were included in the study had right sided calf pains which was also the dominant side for 96% of the sample population.

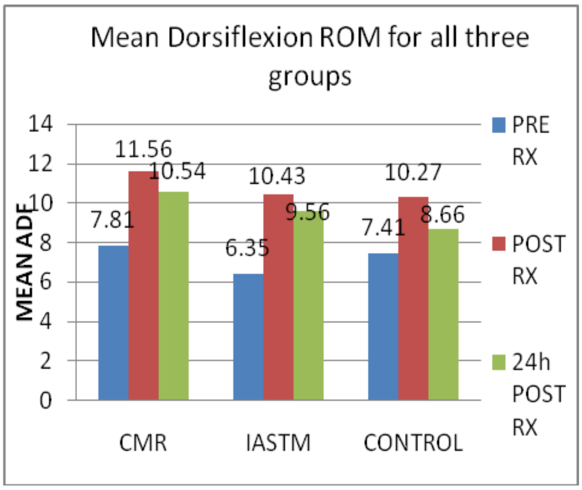

Figure 2: Ankle Dorsiflexion ROM

In the CMR group the mean ankle dorsiflexion pre-treatment (7.80) ROM increases after a single session of CMR (11.56) with mean difference of (-3.76). The carry over effect of CMR on mean ADF post 24 hours of treatment (10.53) decreases marginally with a mean difference of (1.03). The CMR group thus has a significant effect in increasing ADF ROM ($p \leq .004$).

In the IASTM group the mean ADF ROM pre-treatment (6.35) significantly increases after a single session of IASTM (10.43) with a mean difference of (-4.0).
The carryover effect of IASTM on mean ADF post 24 hours of treatment (9.56) decreases marginally with a mean difference of (0.87). The overall effect of IASTM intervention on ADF ROM is statistically significant. ($P \leq 0.005$).

In the Control group the mean ADF pre-treatment (7.41) shows increase after a single intervention (10.26) with mean difference of (-2.85). The carry over effect post 24 hours (8.66) shows significant decrease in ROM with mean difference of (1.6). The overall effect of stretching on ADF ROM is comparatively less significant ($P = 0.025$).

On comparing the effectiveness of all the three groups on Ankle Dorsiflexion ROM using ANOVA two factors with replication, it was seen that it is not statistically significant. ($P>.05$). Hence, null hypothesis was accepted.

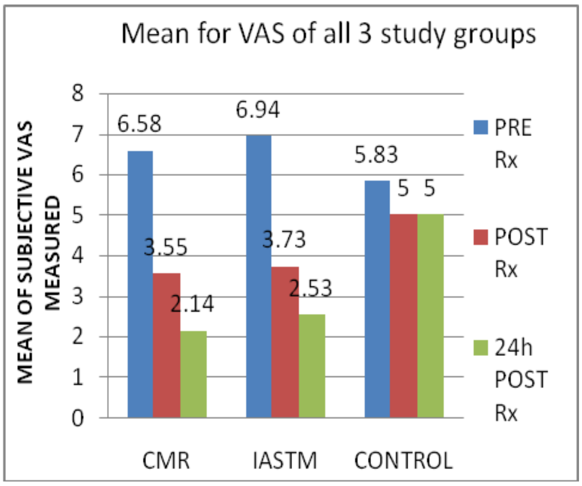

Figure 3: Subjective Pain (VAS)

In the CMR group the mean VAS pre-treatment (6.57) steeply decreases after a single session of CMR (3.54) with mean difference of (3.03). The carry over effect of CMR on mean VAS post 24 hours of treatment (2.14) decreases further with a mean difference of (1.4). Thus, the effect of CMR on subjective pain is highly significant (p= 1.59E-10).
In the IASTM group the mean VAS pre-treatment (6.94) had a sharp decrease after a single session of IASTM (3.72) with a mean difference of (3.22). The carryover of the same post 24 hours of treatment (2.53) again decreased significantly with a mean difference of (1.19). Thus, the effectiveness of IASTM on subjective pain was again highly significant. (P = 1.52E-12)

In the Control group the mean VAS pre-treatment (5.82) shows slight decrease after a single intervention (5.00) with mean difference of (0.82). The carry over effect post 24 hours (5.00) shows no significant change in VAS with mean difference of (0.00). Thus, the overall effectiveness of stretching on reducing pain as a subjective measure was not very significant. ($P \leq 0.05$)

On comparing the effectiveness of all the three groups on subjective pain using ANOVA two-factor with replication, the study shows very high significance. (*P* ≤ 2.69E-05)

OBJECTIVE PAIN (PRESSURE ALGOMETRY)

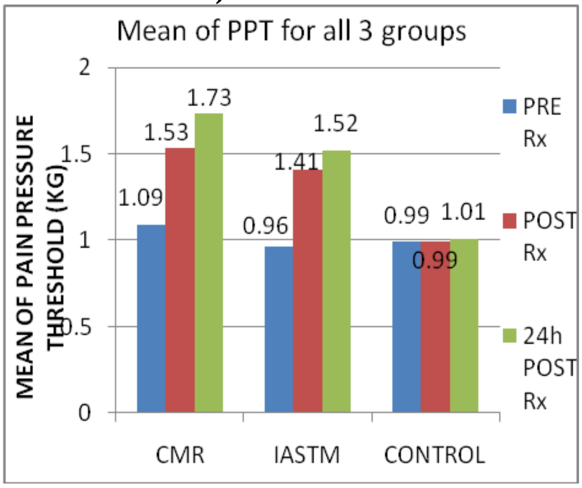

Figure 4: Mean PPT in all 3 groups.

In the CMR group the mean PPT pre-treatment (1.09) increased after a single session of CMR (1.53) KG with mean difference of (-0.44). The carry over effect of the same post 24 hours further increased marginally (1.72) with a mean difference of (-0.19).

The overall effectiveness of CMR on objective pain is (*P*≤ 0.002) indicating high significance.

In the IASTM group the mean PPT pre-treatment (0.96) increased after a single session of IASTM (1.40) with a mean difference of (-0.44).The carryover effect of IASTM on mean ADF post 24 hours of treatment (1.52) decreased marginally with a mean difference of (-0.12).

Thus, the effectiveness of IASTM on reducing pain as an objective measure was significant (*P* ≤ 0.003)

In the Control group the mean PPT pre-treatment (0.99) showed no significant increase after a single intervention (0.99) with mean difference of (0.00). The carry over effect post 24 hours (1.01) shows no significant increase in PPT either with mean difference of (-0.02).

Thus, the overall effectiveness of stretching on reducing pain as an objective measure was not significant. *P*= 0.970602

On comparing the effectiveness between groups on objective pain using ANOVA two-factor with replication, the study shows high significance (*P*=1.94E-05)

DISCUSSION

A total of 48 limbs were included in the study. All patients were suffering from non-specific mechanical calf pain and were aged between 20-40 years of age. It was that 73% of the sample population fell under the age group of 20-24, which could be owing to the high levels of activity undertaken by people of this age group. 65% subjects who were included in the study had right sided calf pain which was also the dominant side for 96% of the sample population. However, 35% subjects also experienced left side involvement which indicates that although majority had right sided involvement it may be irrespective of dominance and may depend upon the limb into greater use.

The experimental study conducted to compare the effectiveness of CMR and IASTM interventions with stretching as a control group show statistically significant results.

In the CMR group the ankle dorsiflexion (*P* value=0.004) shows that CMR has a significant effect in increasing ADF ROM. Also, in the IASTM group the overall effect of the intervention on ADF ROM is statistically significant (P value=0.005) whereas the overall effect of stretching on ADF ROM is comparatively less significant (P value=0.02).

However, on comparing the effectiveness between 3 groups on Ankle Dorsiflexion ROM using ANOVA two-factor with replication, it indicates that the (P value>0.05) is not statistically significant. So, although we know that the mechanism of stretching and MFR is very different; stretching works on lengthening of the shortened muscle fibres while MFR works on remodelling the muscle fibres and associated fascia to restore the normal length tension relationship, but the effect that all three interventions have in increasing joint ROM is more or less the same. Hence, null hypothesis accepted.

In the CMR group the pain pressure threshold pre-treatment increased after a single session of CMR by 140% and further kept increasing in the post 24-hour period. ($P \leq 0.002$) indicating high significance. Similarly, in the IASTM group the PPT increased by 148% after a single session of IASTM with a further increase by 108% post 24 hours of treatment. ($P \leq 0.003$). In the Control group the PPT showed no significant increase even after treatment we can comment that changes at the cellular level in the form of inflammation and healing goes on within the soft tissues even in the post-treatment period. On comparing the effectiveness of all the three groups on objective pain using ANOVA, the study showed high significance *P*=1.94E-05.

VAS for the CMR group steeply decreased after a single session of CMR and further decreased post 24 hours of treatment (*P*= 1.59E-10). This corresponds with the objective pain analysis. Similarly, in the IASTM group the VAS had a sharp decrease after a single session of IASTM and a further significant decrease post 24 hours of treatment. (P= 1.52E-12). In the Control group VAS did not show any significant improvement. On comparing the effectiveness between 3 groups on subjective pain using ANOVA two-factor with replication, the study shows very high significance.(P= 2.69E-05). This shows that the subjective as well as objective pain analysis gave more or less similar results and hence either of both outcomes can be considered reliable.

A study was done on comparison of Compressive MFR and Graston Technique for improving ADF ROM. [2] An RCT was conducted. Two 1-way analysis of variance were done. Post hoc test showed dorsiflexion improvements in the standing position after CMR compared to GT and control groups (both P=0.001). In kneeling position, DF improved after CMR compared with control group (P=.005). Pain was not taken into consideration in this particular study; and weight bearing ADF ROM was taken into consideration whereas in this study NWB ADF ROM is taken into consideration. The control group did not receive any treatment in this particular study.

Nevertheless, the results are more or less the same with more significant improvement in ADF ROM with CMR (P=.004) as compared to IASTM (P=.005), although both would be considered effective.

A study done was on the immediate effect of soleus trigger point release on restricted ankle joint dorsiflexion. [3] A pilot randomised control trial was conducted. Twenty healthy volunteers with restricted ankle dorsiflexion participated in this study. Just like our study the participants underwent a screening process to establish both; a restriction in active ankle dorsiflexion and presence of active and latent MTrPs in the soleus muscle. Participants were randomly allocated to an intervention and control group. The results showed a statistically significant (P=0.03) increase in ankle ROM in the intervention group (TrP pressure release) as compared to control group, which goes hand in hand with our study except that ischaemic compression was coupled with compressive myofascial release for the entire calf muscle which showed a more statistically significant (p=0.004) increase in ankle ROM in the CMR group as compared to control group. The control group did not receive any intervention in the above-mentioned study and there was no direct comparison between two interventions.

The 24-hour post feedback questionnaire that was implicated to the sample population of all three groups indicated that 9 out of 16 sample population in the group A experienced soreness post treatment i.e. 56.25% of the CMR group but only 3 samples retained the soreness post 24 hours of treatment, whereas in group B only 3 out of 16 samples experienced soreness post treatment i.e. 18.75% but 2 retained soreness post 24 hours.

So we see that although greater portion of population of the CMR group experienced soreness, it resolved within 24 hours for majority; whereas out of the very few people who did develop soreness in the IASTM group, majority retained it post 24 hours. So we hypothesize that although the prevalence of subjects experiencing soreness post IASTM is low but once developed it takes more time to resolve. This could be owing to the pressure applied during treatment which cannot be modulated as per the therapist's tactile feedback as there is no direct contact with the skin whilst treatment and hence depends upon patient feedback. On the other hand, in CMR the pressure can be modulated as per the tone and feel of the muscle and the facial adhesions perceived during treatment.

Soft tissue manipulation leads to remodeling of the fascia and induces an inflammatory cascade which induces soreness, it usually subsides within 24-48 hours if there is no pathological involvement. The CMR group experienced more initial soreness as compared to the IASTM group, the reason for which is not known and further studies can be conducted for the same. None of the samples from group C experienced soreness post and 24 hours post treatment which could be owing to the conventional icing intervention they received post treatment.

The subjects from any of the three groups did not experience any significant heaviness or discomfort or any kind of similar or new pain in any other part of the body post treatment, which proves that the interventions did not lead to activation of latent or satellite TrPs. All the 16 samples under the CMR and IASTM groups respectively appreciated improvement in the ease of movement post treatment; whereas only 7 samples from group C experienced improved ease of movement and 9 samples experienced no change at all.

It was seen that among samples who had bilateral limb involvement and both limbs were taken as individual samples, 4 out of 15 i.e. 26% of the sample population preferred CMR over IASTM whereas 60% of the population preferred IASTM as a treatment of choice in terms of patient comfort and better tolerance to treatment. 2 out of 15 samples appreciated both the interventions equally.

CONCLUSION

From this study we conclude that CMR as well as IASTM are useful interventions for reducing pain as well as improving ADF ROM immediately post intervention and also have a good carry over effect wherein CMR plays a slightly more significant role in improving DF ROM than IASTM whereas IASTM proves to be more effective in alleviating pain (p=1.52E-12) CMR (p=1.59E-10).

When patient opinion is taken into consideration the IASTM has an upper hand in terms of patient comfort and better tolerance to treatment. It also minimises the amount of time and efforts put in by the therapist to procure equivalent results. The effectiveness of both interventions is highly significant and should be used in clinical setups for evidence-based practice.

Limitations

A larger sample population can be taken into consideration in areas with high prevalence of trigger points of the calf muscle for e.g. in industrial setups with long hours of standing jobs.

Ultrasonic and histochemical studies can be conducted to understand the physiological changes taking place at the cellular level with different interventions.

Future Scope

Further studies can be conducted to study the effectiveness of instrument assisted techniques for various orthopaedic and neurological conditions wherein pain, ROM deficits and mechanical length tension insufficiency are to be alleviated.

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