

Interventions for Prevention and Treatment of Medial Tibial Stress Syndrome : A Narrative Review

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Abstract

Background: Medial tibial stress syndrome (MTSS) is a common cause of exercise-related leg pain in the athletes and military personals therefore they are frequently addressed by physiotherapists. **Objective:** To review the quality of current published evidence regarding the preventive and treatment strategies for MTSS. **Data source:** Systemic search was carried out in PubMed, PubMed Central and PEDro from January 2022 to May 2022. **Study Design:** The design was chosen to give an overview of previous research about treatment strategies and prevention of MTSS. This review is not a fully comprehensive review as it did not include aggressive treatment protocols such as surgery or drug therapy. **Data Extraction:** Participant's characteristics and other relevant data was extracted from the articles and then tabulated. A 10 item scale was applied to all articles and quality was assessed. **Data Synthesis:** Initial search of the electronic databases produced records: PubMed 48 ; PMC 207; PEDro 62. A total of 317 articles were identified. After review of the title and abstract and removal of duplicates, 117 records were warranted for retrieval. After text review, 13 records met the inclusion criteria and were included in the review. **Limitation:** It was difficult to group studies and quantitatively evaluate outcomes due to the variance in protocols, participant features and outcome measures. **Conclusion:** Several treatment and one preventive strategy were identified for MTSS. A significant reduction in various outcome measures was observed in majority of studies.

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Introduction

Among exercise-induced leg injuries, medial tibial stress syndrome (MTSS) is seen most frequently, it was first described in 1958 (Devas MB., 1958). Peoples who usually perform any activity that puts a repetitive strain on their legs are likely to have lower leg pain (Cymet TC & Sinkov V., 2006). Lower extremity injuries are a very common problem of athletic population, therefore they are frequently addressed by physiotherapists. Along with MTSS these include injuries like chronic compartment syndrome and stress fractures (Yates & White 2004). MTSS is frequently diagnosed as shin splints, shin pain, periostitis, and exercise related lower leg pain (Sharma J et al., 2011). The formal definition of MTSS differ throughout the existent literature. But In 1966, the American Medical Association (AMA) defined shin splints as a "pain or discomfort in the leg from repetitive running on hard surfaces or forcible, excessive use of the foot flexors; diagnosis should be limited to musculotendinous inflammations, excluding fracture or ischemic

disorder". Yates and White, 2004 described MTSS as "pain along the posteromedial border of the tibia that occurs during exercise, excluding pain from ischemic origin or signs of stress fracture." Injuries from repetitive micro trauma occur most frequently when there is change in mode, intensity and duration of training of any physical activity (Wilder RP & Sethi S., 2004). Due to the repetitive nature of running and impact loading on the lower extremities, the more common symptom is localized pain along the distal two-thirds of the posterior medial tibia (Newman P et al., 2013). MTSS is regularly diagnosed in track and field athletes (Willems TM et al., 2006) and 'shin splints' has historically been the generic label associated with any such exercise-induced pain localized in the medial tibia resulting from activities involving repeated foot-to-ground impact. There are many factors that contribute to the pathological pattern of tibial loading and the resulting strain (Cengizhan Özgürbüz et al., 2011). MTSS is the most common causes of exercise-related leg pain among different populations but is predominant in the athletes and military personals therefore they are frequently addressed by physiotherapists. MTSS requires early detection and management. Otherwise, limitations due to repetitive stresses will ensue. There is therefore a need for an overview of the current published literature to find the preventive and evidence based treatment strategies. This study aims to review the quality of current published evidence regarding the preventive and treatment strategies for medial tibial stress syndrome (MTSS).

Research Question

The research questions formed were: (1) What is the quality of studies? (2) To identify prevention methods in current literature that are effective for medial tibial stress syndrome (MTSS)? (3) To identify treatment strategies that are effective for medial tibial stress syndrome (MTSS) in current literature?

Material and method

Data source and search- A comprehensive literature search using electronic database including Pub Med, Pub Med Central and PEDro was under taken to identify literature. No restrictions to publication year were applied to the searches. The keywords used to search the literature were Medial tibial stress syndrome, Rehabilitation and MTSS, Overuse injuries, Shin Splints, Prevention and MTSS

Study Design -The design of the current study is a narrative review. The design was chosen to give an overview of previous research about treatment strategies and prevention of MTSS. This review is not a fully comprehensive review as it did not include aggressive treatment protocols such as surgery or drug therapy.

Data Collection - Between January 2022 and May 2022, searches of electronic and print information sources were conducted to identify all potentially relevant articles. No restrictions to publication year or language were applied to the searches. A PubMed search strategy was developed using 3 concepts: (1) the nomenclature used for MTSS, (2) Rehabilitation of MTSS, and (3) activity related to the development and prevention of MTSS, each with relevant medical subject headings and text words. The PubMed strategy was adapted for PMC for searching the relevant articles in electronic databases. Manual searches of reference list of included articles was undertaken to search for possible studies not captured by the electronic searches. First, the title and abstract were screened for eligibility. Second, the full text papers were assessed to verify whether the study met the inclusion criteria. The inclusion criteria was patients suffering from MTSS, full text available, published in english, published in peer reviewed journal, Randomized Control Trials (RCT's), experimental studies. Initial search of the electronic databases produced records: PubMed 48 ; PMC 207; PEDro 62. A total of 317 articles were identified. After review of the title and abstract and removal of duplicates, 117 records were warranted for retrieval. After text review, 13 records met the inclusion criteria and were included in the review.

Results

The information in the studies was condensed in a tabular manner according to: author(s) name, sample size, mean age, symptom duration, treatment group intervention, control group intervention, length of study, measurable intervals, outcome measure, no. of subjects in treatment group, no. of subjects in control group, retention rate and evaluated. In the present study a total of 14 studies were included. Table 1 details the the quality of the studies. A ten item assessment scale was used in which a rating of 8 and above was given to high quality studies, 5 to 7 rating was given to medium quality studies and 4 and less rating was given to low quality studies. Out of the total 13 included studies 5 studies were given high quality score as they fulfil 8 or more item of the scale. 7 studies were given medium quality score and 1 study was given low quality score as it met only 4 score on the item scale. The characteristics of the included studies were summarized in table 2 and 3. The sample size ranged from 6 to 1020. Five studies included females as participants in their studies and total number was fifty five (McNamara et al., 2019; Mandeley et al., 2006; Schulze et al., 2014; Winter et al., 2018). The symptoms duration was mentioned in eight studies ranging from one week to two years. Of these studies the sample size of majority of studies was less than 50 and 6 studies had a sample size of more than 50. Out of these 6 studies sample size of three studies was more than 400. The mean age of study participants was 22 + 4.1 years and only in one study the mean age was 56.9 years. Out of the 14 studies 4 studies did not reported any symptom duration and in the rest minimum symptom duration was 1 week and maximum was 1740 days. 10 studies did not included any control group to contrast the differences with the treatment group. Studies with control group gave a better understanding of the comparison and effects of treatments. The minimum length of the studies was one week and maximum was 20 weeks and the baseline parameters were measured in all the studies with a measurable interval ranging between 1 week to 20 weeks and no follow up prior to this was observed in any study. The primary outcome in the majority studies was the number of days from inclusion to completion of the programme, VAS, Likert Sclae, GRC, Navicular drop test, Hop Distance, MTSS rate, QoL scale, Heel Rise test. The retention rate in majority of studies was above average.

Discussion

Treatment strategies for MTSS varied in studies due to lack of any specified guidelines in literature. The strategies included grade running programme and graded running programmes & focused ESWT (Moen et al., 2011), Running program with sports compression stockings (Moen et al., 2012), In one study MTSS was treated with 10–14 days of rest (Milgrom et al., 2020), use of the orthotic device, a prescription for activity modification, and ice massage (Johnson et al., 2006), single Y-strip of KT was applied beginning with the tail placed on the proximal third of the medial tibia and foot orthotics consisting of non-custom semi-rigid shoe insoles with medial arch support were given to all of the subjects in the orthotics group (Kachanathu et al., 2017), Tactile stimulation just inferior to the sacroiliac joint with the hip abducted 10 degree as the clinician passively rotates the hip in the medial direction. Tactile stimulation to the gastrosoleus group as the patient actively dorsiflexes the ankle (Martinez et al., 2019). Exercises consisted of stretching, strengthening and ankle stability exercises. Both groups followed the same rehabilitation protocol, the only difference being that one group also received a pneumatic leg brace to wear during running (Moen et al., 2010). 30 min TENS, twice a week; daily slow release 10 mg oxybutynin; TENS+oxybutynin (multimodal); all for 12 weeks (Souto et al., 2013). Taping, cryotherapy, ultrasound and/or other therapeutic modalities (Mandley et al., 2006). Gait retraining, including exercises to increase neuromuscular control and flexibility. The gait-retraining program was effective in reducing MTSS (sharma et al. 2014). Only one study was identified that included the preventive measures for MTSS which included preventive training programme included squats, Lunges Hip

abduction/extension rotation, forefoot lift, coordination and quadriceps stretch (Brushoj et al., 2008).

In a study by Moen et al., 2011 one patient in the running programme group and two patients in the running programme with focused ESWT did not finish the last phase of the running programme due to persisting symptoms. The patient in the running programme group scored a 3 on the Likert scale (somewhat improved) on quitting the study. In the running programme with ESWT group two patients scored 4 on the Likert scale (same) on quitting the study. In total, 39 athletes finished the running programme. In the group of the running programme with ESWT the duration to full recovery was 59.7 (SD 25.8) days. In the group with the running programme only, the duration was 91.6 (SD 43.0) days. The means were significantly different between the groups ($p=0.008$), with treatment explaining 17.5% of the total variance in the number of days to full recovery.

The mean pre- test ankle ROM for the device leg was $9.85 \text{ cm} \pm 0.8 \text{ cm}$ (range 5 – 13.5 cm) and the mean post-test ankle ROM was $11.63 \text{ cm} \pm 0.7 \text{ cm}$ (range 8.3 – 16cm). This represented an average improvement of 21 % ($p < 0.0001$). The mean pre-test ankle ROM for the control leg was $9.25 \text{ cm} \pm 0.74 \text{ cm}$ (range 4 – 12 cm) and the mean post-test ankle ROM was $9.5 \text{ cm} \pm 0.8 \text{ cm}$ (range 4 – 12 cm). Ankle ROM improved by 3 %, however, this difference was not statistically significant ($p > 0.05$). When comparing ankle ROM improvement between groups the device group had a significantly greater improvement ($p < 0.0001$) despite a statistically similar pre-test result ($p > 0.05$) (McNamara et al., 2019).

After 10 sessions of physiotherapy over a period of 10 weeks the patient reported being able to perform his daily activities, including standing, walking, as well as participating in sports activities without pain during or following participation; 2) He did not experience pain on palpation of the medial tibial border bilaterally; 3) Taut bands were still present on palpation of calf muscles; 4) Minimal changes in hypomobility to passive mobilization of the ankle (dorsiflexion and eversion), active range of motion measurement are reported in; 5) Bilateral ankle valgus, bilateral longitudinal plantar arch fall and pelvic retroversion did not present modifications; and 6) A decrease in abrupt contact of the midfoot and the forefoot in running support phase was observed (Gonzalez et al., 2020).

In a study by Kachanathu et al., 2017 statistically significant improvement after both interventions in terms of VAS and hop distance was observed. These biomechanical findings support the clinical practice of using anti-pronation taping at the first consultation to control abnormal pronation, although the effect on navicular drop correction was insignificant. In addition to its restrictive effects, kinesiotaping may also have neuromuscular effects including changes in muscle activity. KT is elastic and reportedly increases local circulation, reduces edema, facilitates muscle activity, and improves joint function by enhancing sensory mechanisms. Taping creates a pulling effect on the skin during movements, suggesting that it may be caused by enhanced stimulation of the cutaneous receptors by the close contact between the tape and the skin. Moreover the tape may increase cutaneous input which increases the excitability of the motor neuron pool. Although the scientific basis of the taping remains unclear, it is generally agreed that taping has a combination of mechanical and neuromuscular effects.

In a study by Schulze et al., 2014 the average duration of treatment was $6.3 (\pm 4.3)$ days. On average, four treatment sessions (± 2.0) were performed until the therapy was terminated. During the course of the therapy, the average level of exercise-induced pain on the visual analogue scale (VAS) could be reduced from 5.2 ± 1.5 points to 1.1 ± 1.7 points (end of treatment) ($P < 0.001$). After the first treatment, the average level of pain sensation was already reduced to 3.1 ± 1.8 points ($P < 0.001$; Figure 1). Three patients were already pain-free after the first treatment (from 5 points to 0 points on the VAS). In total, 53% of patients were pain-free at the end of treatment (VAS: 0). Among the other 47%, the average level of complaints could be reduced from 5.3 ± 1 points to 2.3

± 1.8 points on the VAS. Pain-Free Running Distance. After completion of treatment, 60% of all participants could run a distance of more than 3000m without pain. An improvement of the initial condition was achieved in further 19% of all participants. In these cases, the level of complaints was reduced from a score of 4.2 ± 0.4 to a score of 1.7 ± 0.8 . 19% reported that no improvement was observed. One patient reported a deterioration in his condition after the first treatment and quit the study at his own request. In total, the score could be improved from 3.2 to 1 ($P < 0.001$). 22% reported that they had run more than 3000 m (score reduced from 2.4 to 0) already after the first treatment. In total, the score for the running distance could be improved from 3.2 to 2.3 after the first treatment ($P = 0.002$). Speed without Pain. When the therapy was terminated, 56% of all patients managed to accomplish each of the speed levels specified without experiencing any pain. An improvement was achieved in 35% of all patients. Their score was improved from 2.7 to 1.4. In total, the score was improved from 2.4 to 0.7 ($P < 0.001$). In two cases, no effect could be achieved in terms of speed. One patient reported a deterioration in the score (score increased from 2 to 3). After the first treatment, 13% reported that they could run at each speed specified (score reduced from 2.3 to 0). In total, the score could be improved from 2.4 to 1.8 after the first treatment ($P = 0.001$). Ability to Jump without Pain. In total, the score for the ability to jump could be improved from 1.4 to 0.4 ($P < 0.001$; Figure 4). 66% of all patients stated that they were free of symptoms when the therapy was terminated (score reduced from 1.3 to 0). The ability to jump could be improved in further 22% of all patients (score reduced from 1.7 to 1). The therapy had no effect on the ability to jump in 9% of all cases. One patient experienced a deterioration (score increased from 1 to 1.5). 32% of all patients reported that they were able to jump without pain after the first treatment (score reduced from 1 to 0). In total, the score could already be improved from 1.4 to 0.8 after the first treatment ($P < 0.001$) Shin Splint Score. All capabilities sum to an exercise tolerance score with a maximum of 12 points. On average, the overall score was reduced from 7 (SD ± 2.4) to 2.1 (SD ± 2.8) ($P < 0.001$). 50% of all patients were completely free of symptoms after completion of treatment. Further 38% of all patients experienced an improvement in their symptoms (score reduced from 8 to 3.5). In 6% of all cases, it was not possible to prove an effect until termination of treatment. Two patients experienced a deterioration of their symptoms. After the first day of treatment, 13% of all patients were completely free of symptoms (score reduced from 6.8 to 0), and the overall score was improved from 7 to 4.9 after the first treatment ($P < 0.001$).

Conclusion

The aim of this study was to review the current published evidence regarding the preventive and treatment strategies for medial tibial stress syndrome (MTSS). Several treatment and one preventive strategy were identified for MTSS. A significant reduction in various outcome measures was observed in majority of studies.

Table 1. Quality assessment scale (10 items)

Study id	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10	Quality
Moen et al, 2011	1	1	1	0	0	0	0	1	1	1	M
Moen et al, 2012	1	0	1	0	1	1	1	1	1	1	H
W. McNamara et al, 2019	1	0	1	0	1	1	0	0	1	1	M
CTP Ember Johnston & AMSC USA, 2006	1	1	1	1	1	1	1	0	1	0	H
Shaji John Kachanathu, 2017	1	0	1	0	1	1	1	0	1	1	M
ChristofferBrushøj et. al, 2008	1	0	1	1	1	1	1	1	0	1	H
Christoph Schulze et.at, 2014	1	1	1	0	0	1	0	1	1	1	M
Rodrigo E. Martinez et. al, 2019	1	0	1	0	0	0	1	1	1	1	M
Marinus Winters et. at , 2018	1	1	1	0	0	1	0	0	1	1	M
MH Moen et. al. 2010	1	1	1	0	1	1	0	1	1	1	H
Luke T Madeley et. al, 2006	1	1	1	0	0	0	1	1	1	1	M
Jagannath Sharma et.al, 2014	1	0	1	1	1	0	1	1	1	1	H
Charles Milgrom et. al, 2020	1	0	1	0	0	0	0	1	0	1	L

1= Yes; 0= No

10 item quality assessment scale

Item 1	Is the aim clearly stated?
Item 2	Is the place of study mentioned?
Item 3	Adequate description of the sample and eligibility criteria?
Item 4	Was control group included?
Item 5	Subjects were randomly allocated?
Item 6	The groups were similar at base line regarding the most important prognostic indicator?
Item 7	Adequate descriptions of the methods used to collect data regarding primary outcomes?
Item 8	Adequate description of the data analysis?
Item 9	Did the authors report limitations?
Item 10	Can the results be generalized?

Table 2. Characteristics of study included in the review

Study ID/Author	Sample size	Mean Age	Symptoms Duration	Treatment Group	Control Group	Length of study	Measurable Intervals	Outcomes Measure (primary/secondary)
Moen M.H ;et al (2011)	N=42 Running program (20) & Running program +focused ESWT(22)	Running program=22.7 & Running program + focus ed ESW T=30	Running program-189.3 days & Running program + ESWT629.2 days	Patients from one hospital were treated with a grade running programme while patients from the other hospital were treated with same graded running programmes & focused ESWT	No	9 weeks	<i>Baseline 9 Weeks</i>	The no. of days from inclusion to completion of phase 6 of the running schedule. Time to full recovery (the end point was being able to run 18 min. conservative without pain at fixed intensity Likert Scale (when patient did not fully recover)
Maarten Hendrik Moen (2012)	N= 74 Running program (25) Running program with exercises (24) Running program And sports compression stocking (25)	Running program - 22.2 Running program with exercises - 20.7 Running program And sports compression stocking-23	Running program - 1780 days Running program with exercises - 1740 days Running program And sports compression stocking- 2137days	First group is treat with Running program while second group treat with Running program with exercises &third group treat with sports compression stockings	No	278 days	<i>Baseline 40 weeks</i>	The no. of days from inclusion to the completion of phase six of the running schedule. Likert scale

W. McNamara et . al. 2019	N=30 Males =16 Females =14	24 ± 0.5 years	No	Participants wore the device for one hour whilst being allowed to rest or complete light exercises	The contralateral leg was used as a control.	One hour	The mean pre- test ankle ROM for the device leg was 9.85 cm ± 0.8 cm (range 5 – 13.5 cm) and the mean post- test ankle ROM was 11.63 cm ± 0.7 cm. The mean pre- test ankle ROM for the control leg was 9.25 cm ± 0.74 cm (range 4 – 12 cm) and the mean post- test ankle ROM was 9.5	Several lower limb disorders where improving ankle ROM can reduce symptoms or play a role in preventing or slowing disease pathophysiology.
Charles Milgrom et. al, 2020	N= 429	19.4 ± 0.9 years	14 weeks	Treated with 10–14 days of rest	No	4 weeks	Baseline 2-3 weeks	The treatment protocol without the use of imaging was found to be effective in more than two-thirds of the cases
CTP Ember Johnston & AMSC USA 2006	N=25 Brace Group (n =12) Control Group (n=13)	Brace Group 22.33 ± 3.89 years Control Group 22 ± 5.05	Brace Group 48.6 ± 27.3 Control Group 39.7 ± 29.9	Treatment for the experimental group included use of the orthotic device, a prescription for activity modification, and ice massage	Treatment for subjects in the control group was identical to that for the experimental group except that no orthotic	6 weeks	Baseline 6 weeks	Successful completion of 0.5 mile pain free or completion of 6 th week GRC VAS

					device was used.			
Shaji John Kachanathu 2017	N=40 kinesio taping group=20. An orthotics group=20	24.16 ± 2.6 years	> 1 week	<i>Tapping group:</i> single Y-strip of KT was applied beginning with the tail placed on the proximal third of the medial tibia. <i>Foot orthotics:</i> consisting of non-custom semi-rigid shoe insoles with medial arch support were given to all of the subjects in the orthotics group	No	1 week	Base line 1 week	Navicular drop test VAS Hop Distance
Christoffer Brushøj et al, 2008	N=1020	20.9 years	No	Prevention training programme Squats Lunges Hip abduction/extension rotation 3. Forefoot lift 4. Coordination 5. Quadriceps stretch	Placebo group Abdominal curls Back extension Biceps towel curl Triceps towel curl Pectoralis stretch	12weeks	Baseline After every 2 weeks	The primary outcome was defined as overuse knee injuries (PFPS, ITBFS, jumper's knee) or MTSS. The secondary outcome was defined as any injury to the lower extremity
Christoph	N=32	26.3 ±	In 19	Fascial	No	1 week	Every day	VAS

Schulze et.al, 2014	Males=3 0 Females =2	4.1 years	present for 1 week In 6 present for 8.5 weeks in mean In 7 present for 2.5 year in mean	Distortion Model					Pain free running distance Speed without pain Shin Splint Score
Rodrigo E. Martinez et. al, 2019	N= 18 Males =12 Females =6	19.89 ± 1.32 years	3 weeks	Tactile stimulation just inferior to the sacroiliac joint with the hip abducted 10 degree as the clinician passively rotates the hip in the medial direction Tactile stimulation to the gastroc- soleus group as the patient actively dorsiflexes the ankle.	No	1 week	Baseline 1 week		NPRS DPA scale
Marinus Winters et. at , 2018	N=6 Male=1 Females =5	22.6 years	2 years	Fasciotomy and periosteal stripping was offered. All athletes received post- surgery rehabilitation consisting of rest and gradual loading.	No	15 weeks	Baseline 15 weeks		This effect could be exacerbated by the failure of a repair response in those individuals that eventually present with MTSS; remodeling around microcracks was almost

								never observed in this sample.
MH Moen et. al. 2010	N=15 Rehabilitation program without brace (N=7) Rehabilitation program with brace (N=8)	Brace group =19.1 ±1.9 No brace group =18.6 ±1.2	Brace group =32.9 ±20.2 No brace group =35.1 ±16.9	These exercises consisted of stretching, strengthening and ankle stability exercises. Both groups followed the same rehabilitation protocol, the only difference being that one group also received a pneumatic leg brace to wear during running.	No	Brace 58.8 ±27.7 days Non-brace 57.9 ±26.2 days	Baseline 2 weeks	The primary outcome measure was the time from beginning rehabilitation to completing Phase 6 of the running program without pain. SARS Satisfaction with treatment
Luke T Madeley et. al, 2006	N=60 MTSS Group =30 (16male & 14 female) Without MTSS Group =30 (16male & 14 female)	MTSS Group =24.0, S.D. 5.7 Without MTSS Group =22.8, S.D. 5.2	15 weeks	Taping, cryotherapy, ultrasound and/or other therapeutic modalities	No	4 weeks	Baseline 4 weeks	Heel-rise test
Jagannath Sharma et.al, 2014	N=450 Medial tibial stress syndrome (n = 166) Intervention (n = 83)	20.1 ±2.0 years	No	Gait retraining, including exercises to increase neuromuscular control and	No	26 Weeks	Baseline 20 weeks	The intervention was associated with a substantially reduced instantaneous

	Control (n = 83) group.			flexibility				relative risk of medial tibial stress syndrome versus control group.
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Table 3. Summary of studies included in the study

Study ID/Authors	No. Of patients in treatment group	No. of patients in control group	Retention Rate	Results
Moen M.H et al, 2011	N=42	No	N=39	Recovery ESWT group with graded running programme 59.7±25.8 days Graded running programm 91.6±43.0 days
Maarten Hendrik Moen, 2012	N=74	No	N=60	Time to complete a running program and general satisfaction with the treatment were not significantly different between the three treatment groups
W. McNamara et al, 2019	N=30	N=30 (contralateral leg)	N=30	The mean pre- test ankle ROM for the device leg was 9.85 cm ± 0.8 cm (range 5 – 13.5 cm) and the mean post-test ankle ROM was 11.63 cm ± 0.7 cm The mean pre-test ankle ROM for the control leg was 9.25 cm ± 0.74 cm (range 4 – 12 cm) and the mean post-test ankle ROM was 9.5 cm ± 0.8 cm
Raúl Ernesto Cortés González, 2020	N=1	No	N=1	Complete pain resolution and full return to sport after 10 weeks of intervention for the patient
CTP Ember Johnston & AMSC USA, 2006	N=7	N=6	N=13	Two subjects reported some relief of shin pain with the use of the shin orthosis. Five subjects reported no improvement or worsening of symptoms with the device.
Shaji John Kachanathu, 2017	N=40	No	N=40	Patients in both groups benefited, but the response to kinesio taping was better than that to orthotics
Christoffer Brushøj et. al, 2008	N=1030	No	N=977	The soldiers in the prevention group had the greater improvement in running distance in 12-minute run tests
Christoph Schulze et.at, 2014	N=32	No	N=32	A significant reduction of the VAS pain score from 5.2 to 1.1 could be achieved

Rodrigo E. Martinez et. al, 2019	N=18	No	N=18	Participants treated with the MYK System experienced significant improvements and appear to surpass traditional interventions without the need of rest.
Marinus Winters1 et. at , 2018	N=6	No	N=6	2 patients returned to sports 3 patients pain while doing ADL 1 patient pain free after 3months of treatment
MH Moen et. al. 2010	N=15	N=7	N=14	Sports Activity Rating Scale (SARS) score Brace group (75.7 ± 21.3) No brace group (74.3 ± 10.2)
Luke T Madeley et. al, 2006	N=30	No	N=23	Athletes with MTSS have endurance deficits of the ankle joint plantar flexor muscles
Jagannath Sharma et.al, 2014	N=166	N=83	N=134	The gait-retraining program was effective in reducing medial tibial stress syndrome incidence
Charles Milgrom et. al, (2020)	N=49	No	N=26	An initial treatment protocol without the use of imaging was found to be effective in more than two-thirds of the cases.

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