RESEARCH PAPER

The Effectiveness of Tibialis Muscle Strengthening Exercises on Shin Splint Pain in Police Training Students

Pratiksha Uddhav Jadhavar[1], Dr. Satyam Bhodaji[2]

[1]Intern, Krishna College of Physiotherapy, Krishna Vishwa Vidyapeeth "Deemed to be University", Karad, Maharashtra, India.

[2]HOD and Associate Professor, Department of Geriatric Physiotherapy, Krishna College of Physiotherapy, Krishna Vishwa Vidyapeeth "Deemed to be University", Karad, Maharashtra, India.

ABSTRACT

Background: Medial tibial stress syndrome (MTSS) is usually called shin splints, and is also an injury that is often seen in people who are highly active and participate in repetitive-impact activities (for example, running, jumping, marching and training). Typically it will present as pain along the posterior-medial angle of the tibia either during or after activity. Police training students are at risk for developing shin splint pain because their training involves extensive rehabilitation which includes a lot of activities such as repeated running, marching, jumping and running long distances (endurance activities), and carrying heavy loads (load-bearing exercises) which all place tremendous/continuous stress upon the tibia and surrounding muscles (i.e. tibialis anterior and tibialis posterior).

Typically for the management of people with shin splints, they are given rest, ice, anti-inflammatories (analgesics), stretching, changing to a lower-impact activity, proper shoes, orthotics, and a gradual return of activity. The usual management strategies generally will focus on relieving the pain and applying a temporal off-loading of the load but not focusing on any of the underlying muscular weakness and biomechanical deficiencies that may still exist. Weakness in the tibialis muscles may cause a decrease in shock absorption capabilities of the lower extremity, change foot mechanics, and increase stress on the tibia during training. Therefore, if individuals complete a rehabilitation program to specifically strengthen those muscles in order to improve their overall lower extremity stability, alleviate discomfort, provide more optimized function, and prevent future occurrences of developing shin splints, this may occur for police cadets.

Materials and Methods: The study was based on an experimental-one-group pre- and post-test, among 40 out of the 400 students at a police training facility at Satara District, who were diagnosed with medial tibial stress syndrome/shin splint pain. A convenient sampling method was used for selection. Inclusion criteria were such that the students were: Within the age group of 18 to 25 years; clinically diagnosed with MTSS; experienced shin pain during or after training; and gave informed consent. The exclusion criteria in students were: any fracture, surgery, deformity, or neurological/vascular disorders of the lower limb, or lower limb injuries within the last three months.

A pain assessment was conducted before and after the intervention using the Visual Analogue Scale for pain, Hand-held Dynamometry for tibialis muscle strength, and Shin Pain Scoring System for functional limitation. Each participant underwent a supervised program of tibialis muscle strengthening for 6 weeks: dorsiflexion, toe raises, resisted inversion, heel raises with inversion, eccentric heel lowering, balance training, and functional drills were performed 5 times per week. The data were analysed using a pre-post test analysis, setting the statistically significant cutoff point or p-value at < 0.05.

Results: The paired t-test analysis showed a highly significant reduction in shin splints pain after 6 weeks of tibialis muscle strength exercises. The mean VAS score decreased from 6.88 ± 0.94 to 1.80 ± 0.85 with a mean difference of 5.08 ($t = 25.71$, $p < 0.001$). Hand-held dynamometer scores for tibialis muscle strength indicated a highly significant improvement with the mean scores increasing from 18.93 ± 3.42 kg to 27.50 ± 3.50 kg producing a mean difference of 8.58 kg ($t = 50.06$, $p < 0.001$).

For the shin pain scoring system, the mean score decreased from 6.03 ± 0.92 to 1.55 ± 0.50 with a mean difference of 4.48 ($t = 26.65$, $p < 0.001$). The total outcome measures showed statistically significant improvement after the intervention indicating that tibialis muscle strengthening exercises were effective for reducing shin splints pain, improving tibialis muscle strength, and providing better functional activity among police training students with Subjective Medial Tibial Stress Syndrome.

Conclusion :In summary, an exercise program for strengthening the tibialis muscles over six weeks helped police training students with Medial Tibial Stress Syndrome (shin splints) to experience less pain and a higher level of functional activity. There was a greater than 50% decrease in pain from both Visual Analog Scale and Shin Pain Scoring System measuring, and there was an increase in the amount of force produced by the tibialis muscles as indicated by the Hand-Held Dynamometry (HHD) measurements after the intervention.

Targeted strengthening of the tibialis anterior and tibialis posterior muscle groups is a straightforward, safe, inexpensive, and effective physiotherapy treatment for reducing shin splint pain in the police training population. Other benefits of using this type of program may include enhanced shock-absorbing ability, increased lower limb stability, higher training tolerance, and decreased risk of recurrence during high-impact police training exercises.

Keywords: Medial Tibial Stress Syndrome, Shin Splint Pain, Tibialis Muscle Strengthening, Police Training Students, Visual Analogue Scale, Hand-Held Dynamometry, Shin Pain Scoring System

**Author for Correspondence:*

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INTRODUCTION

Medial Tibial Stress Syndrome (MTSS) or shin splints is an overuse injury that typically occurs in individuals who frequently participate in high-impact activities such as running, jumping, marching, and drill training. People experiencing MTSS report pain in the posterior medial aspect of the tibia during or after physical activity. In addition, military personnel who are training for their first physical fitness test report experiencing shin splints. [1]

MTSS is also frequently seen in runners, athletes, military recruits, and other physically active individuals subjected to repeated stresses on their lower limbs. Recognizing MTSS through an accurate diagnosis and taking steps to manage it will provide a better chance for recovery and reduce the risk of further developing symptoms or residual effects from a delay in recovery. [2]

The typical conservative management of MTSS includes rest, application of ice, use of pain medications (oral analgesics), stretching, changing activity levels, wearing the proper types of shoes and using orthotics, strengthening exercise programs, and gradually returning to activities after they have become symptomatic. However, many traditional treatments primarily focus on alleviating pain and reducing the load temporarily, rather than addressing the weakness of the muscles or the biomechanical abnormalities associated with the condition. [3]

The Shin Pain Scoring System (SPSS) is a useful tool for quantifying severity of pain, measuring limitations in activity, and tracking progress in an individual with medial tibial stress syndrome (MTSS). The SPSS can be used to monitor improvements during treatment, and also for evaluating the effectiveness of the treatment after it has been conducted. [4]

Muscle strength assessment is also important when diagnosing MTSS as the weakness of the lower leg muscles can affect the ability to absorb shock and lead to improper foot mechanics. There are several types of measurement tools available that can assess muscle strength. A handheld dynamometer is a reliable and objective way to assess the strength of the tibialis muscles pre- and post-intervention for an exercise program to improve lower leg strength. [5]

Police recruits participating in training exercises are frequently at risk for developing shin splint pain due to performing repetitively repeated drill-type of running, marching, hopping exercises, and endurance activities with a weighted load. The repetitiveness of these exercises causes a continuous force applied to the tibia and surrounding musculature (especially anterior tibialis and posterior tibialis). [6]

The factors contributing to the development of MTSS include various training errors, wearing the wrong shoes, excessive training on hard surfaces, having biomechanical problems like being 'knocked-kneed' or 'flat-footed', lack of muscle balance, overpronation of the foot (which causes your feet to roll inward), and decreased ability to absorb shock. All of these potential causative circumstances point to the need for effective preventive and rehabilitation treatment methods for people who are physically active. [7]

By providing improved muscular endurance, strength, and lower limb control through a rehabilitation program involving exercise-based treatments, it may be possible to alleviate symptoms attributed to MTSS. Increased strength following a rehabilitation program may improve functioning, as well as decrease the restrictions associated with having shin splints. [8]

A range of preventive interventions for this condition are necessary because re-injuries can occur again if physical activity resumes without having eliminated some or all of the known risk factors. A rehabilitative programme focusing on neuromuscular control, strengthening, gradual increase of intensity during exercise, and biomechanical improvement have all been shown to have beneficial effects on preventing re-injury. [9]

The physiotherapist managing someone with shin splints will have a range of options to help them return to the activity safely. A physiotherapist should be able to provide pain relief, flexibility development, functional strength training, and correction of any abnormal movement patterns. The physiotherapist will also be able to create a structured plan for rehabilitation that allows the person with shin splints to regain normal physical ability. [10]

It is important that people who are physically active have some knowledge about MTSS, including its potential causes, how to prevent it, and how to treat it. Lack of knowledge about the early warning signs of MTSS, improper training, and not seeing a physiotherapist quickly after developing shin pain can lead to increased amounts of shin pain and decreased physical performance. [11]

Police officers in training must meet a very high level of fitness, similar to military recruits, through their physical training, which includes high levels of cardiovascular and muscular endurance, frequent running, marching, and carrying heavy loads. Because MTSS is commonly seen in the military population, this information can also be useful for police officer trainees who have similar demands placed on them by their training programs. [12]

Running rehabilitation and adjustment of incorrect leg movement should be incorporated into MTSS treatment due to the fact that improper weight patterns lead to increased stress on the tibia. Enhancing the way one runs could lessen the amount of repetitive strain placed on the tibia's bones; thus it may indirectly lessen the occurrence of MTSS by addressing the cause of the problem. [13]

Proximal muscle weakness potentially could negatively impact the biomechanics of lower extremities as well. Disturbance of the hip to the side or downwards, also known as a "pelvic drop", will have a negative impact on one's ability to keep the knee aligned; therefore greater forces will be present across the femur and should be

managed with hip strengthening exercises when attempting to rehabilitate MTSS. [14]

Foot muscle movement is another contributing factor to MTSS. Strengthening exercises, known as "short-foot" exercises, can improve the activation of the muscles found within the foot as well; they can help support the medial arch, decrease significant amounts of foot flattening due to "excessive pronation" and also improve the stability of the foot during any weight-bearing activity. [15]

The use of foot orthotics, strengthening exercises, shockwave therapy, and ice may all usefully assist with MTSS treatment, but exercise should still remain an integral component to recovery because it increases muscle strength and functional control while improving long-term recovery. [16]

The alterations in lower-leg muscle structure and function seen in individuals with MTSS support the role of dysfunctions in the tibialis anterior and posterior in shin pain, and the findings underline the importance of specific tibialis strengthening. [17]

Results from the study support the hypothesis that lower-limb muscle tendons and functional characteristics are closely related to MTSS symptoms; thereby rehabilitation should be directed towards the relief of pain, the improvement of muscle performance, and the endurance of function. [18]

Some studies have suggested that neuromuscular training may provide protection against MTSS by improving balance, coordination, alignment of the lower limbs, and control of lower limb movement; and that balance and proprioceptive exercises might be appropriate supplementary work for tibialis strengthening and reducing recurrence. [19]

Risk factors for developing MTSS include an increase in training load, poor biomechanical patterns, a prior injury, lack of conditioning, and weaknesses of lower-limb muscles. It is important to identify and correct these risk factors in physiotherapy programs of police training students. [20]

Thus, the objective of this pilot study is to evaluate the effectiveness of a six-week structured tibialis strengthening regimen for controlled shin splint pain in police training students. The regimen includes resisted dorsiflexion, resisted inversion, toe raises, heel raises in inversion, eccentric heel-lowering exercises, balance training, and functional training to diminish pain, bolster tibialis strength, and rectify functional performance.

Participants

The research was conducted with permission from the students who took part in Police training classes. Students between 18 and 25 years old and with clinically diagnosed Medial Tibial Stress Syndrome (MTSS) who had shin pain while training were eligible to participate in the study. Students were also required to have signed the consent forms authorizing their participation.

Participants were police recruits who were recruited from Police training facilities in Satara District and were regularly involved in activities of running, marching, jumping, and drills as part of their police training coursework.

Exclusion criteria included having a history of fractures in lower limbs, any type of lower limb surgery, having a deformity in a lower limb, having any type of neurological disorder or vascular disorder affecting a lower limb, and having sustained an acute injury to lower limbs within three months from start of the study date.

Procedure

After obtaining ethical approval, police training students were screened according to the inclusion and exclusion criteria. The study procedure, benefits, and possible risks were explained to the participants, and written informed consent was obtained. Eligible participants with Medial Tibial Stress Syndrome/shin splint pain were enrolled in the study. Baseline assessment was recorded before starting the intervention using the Visual Analogue Scale for pain intensity, Hand-Held Dynamometry for tibialis muscle strength, and Shin Pain Scoring System for functional limitation.

All participants received a supervised 6-week tibialis muscle strengthening exercise program, 5 sessions per week. The exercise protocol included resisted dorsiflexion, toe raises, resisted inversion, heel raises with slight inversion, eccentric heel-lowering, isometric tibialis holds, single-leg stance, wobble board drills, perturbation training, hopping drills, and marching drills with load simulation. The intensity of exercises was progressed weekly according to participant tolerance and performance. After completion of 6 weeks, post-intervention assessment was recorded using the same outcome measures, and pre-test and post-test values were compared to evaluate the effectiveness of the intervention.

Ethical approval and participation consent

The ethical approval for undertaking the suggested studies has been obtained from the Institutional Committee of Ethics of Krishna Vishwa Vidyapeeth (Deemed to be University), Karad, Maharashtra, India, vide their letter no. KVV/ IEC/02/2026 dated January 22, 2026. Every participant provided their informed permission in writing after being given the assurances of confidentiality and the freedom to discontinue participation at any moment.

Outcome measures

Pre and post 6-week intervention measures have been recorded in order to assess the tibialis muscle strengthening exercises effectiveness on shin splint pain; It assessed both tibialis muscle strength and functional activity After completion of each session participants assessed their level of shin splint pain using the Visual Analogue Scale (VAS) which is used to measure level of shin splint pain experienced prior to and following treatment.

Tibialis muscle strength was also measured using Hand Held Dynamometry it supplied an objective measurement of muscle strength. Assessment of functional limitations as well as severity of shin splint pain were performed using Shin Pain Scoring System. Reductions in VAS and Shin Pain Scoring System scores indicate decreased levels of

pain and/or improved levels of functional activity while improvement on Hand Held Dynamometry measurements indicate improvement to the tibialis muscle.

Statistical analysis

Statistical methods were used to analyse the data collected. Demographic information such as age, gender, height, weight, body mass index (BMI), leg dominance, training duration, type of shoe, and previous lower limb injury were summarised as descriptive statistics. Continuous variables were reported using the mean and standard deviation.

The scores for visual analogue scale (VAS) pain scores, hand-held dynamometry (HHD), and shin pain score (SPS) at baseline (pre-participation in exercise program) were compared to the scores after completing the tibialis muscle strengthening exercise program (post-participation in exercise program) from the same participant. Since there was only 1 treatment group and this was a pre-test/post-test cohort study, a two-tailed paired t-test was used to analyse the results. Statistical significance was determined using an alpha level of $p < 0.05$.

RESULTS

The present study included 40 police training students diagnosed with Medial Tibial Stress Syndrome (MTSS)/shin splint pain. All participants fulfilled the inclusion criteria and completed the 6-week tibialis muscle strengthening exercise program without dropout. Pre-test and post-test assessments were recorded for all participants and included in the final statistical analysis

.

Table 1: Age Distribution of Participants (n = 40)

Age Group (Years)	Frequency (n)	Percentage (%)
18–20	10	25.0%
21–23	21	52.5%
24–26	9	22.5%
Total	**40**	**100%**

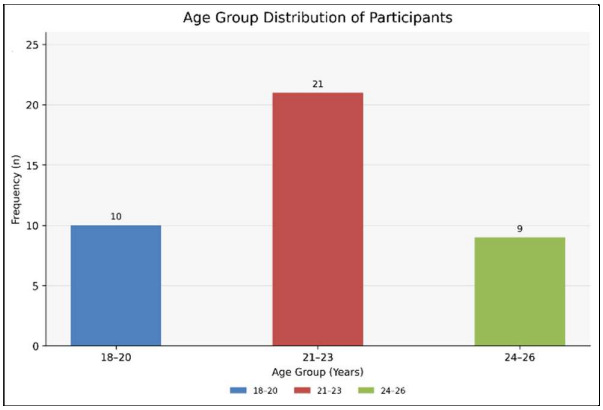


Figure 1: Age Distribution of Participants

Interpretation:
The majority of participants, 52.5%, were in the 21–23 years age group, followed by 25.0% in the 18–20 years age group and 22.5% in the 24–26 years age group.

Table 2: BMI Distribution of Participants (n = 40)

BMI Category	Frequency (n)	Percentage (%)
Underweight (<18.5 kg/m²)	0	0.0%
Normal (18.5–24.9 kg/m²)	36	90.0%
Overweight (25.0–29.9 kg/m²)	4	10.0%
Obese (≥30 kg/m²)	0	0.0%

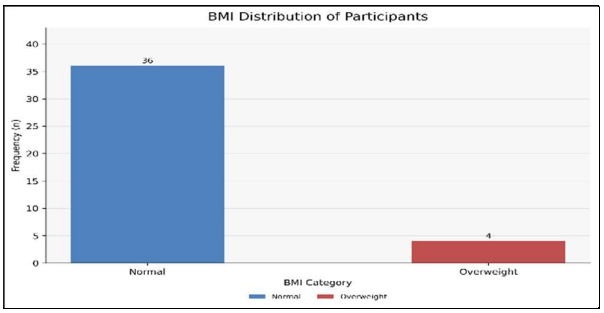


Figure 2: BMI Distribution of Participants

Interpretation:
The majority of participants, 90.0%, had normal BMI, while 10.0% were in the overweight category. No participants were underweight or obese.

Table 3: Duration of Training Distribution of Participants (n = 40)

Duration of Training (Months)	**Frequency (n)**	**Percentage (%)**
3 months	12	30.0%
4 months	14	35.0%
5 months	14	35.0%
Total	**40**	**100%**

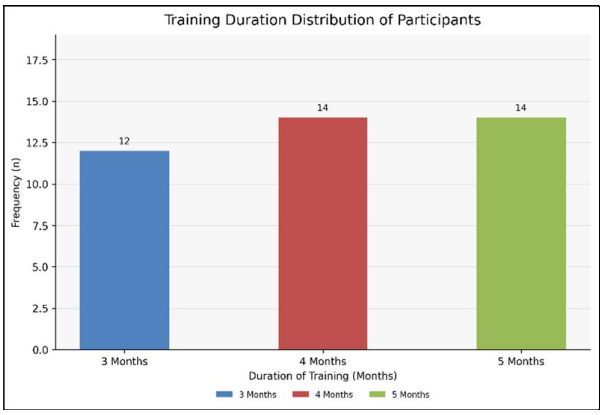


Figure 3: Duration of Training Distribution of Participants

Interpretation:
Most participants had a training duration of 4 months and 5 months, each representing 35.0% of the sample, followed by 30.0% with 3 months of training.

Table 4: Gender Distribution of Participants (n = 40)

Gender	**Frequency (n)**	**Percentage (%)**
Male	28	70.0%
Female	12	30.0%
Total	**40**	**100%**

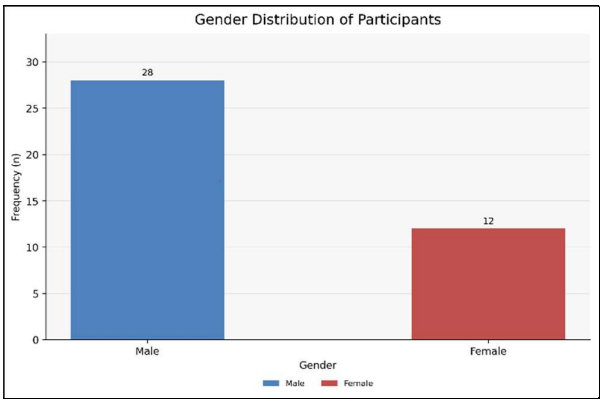


Figure 4: Gender Distribution of Participants

Interpretation:

The study included 70.0% male and 30.0% female participants, representing both genders involved in police training.

Table 5: Leg Dominance Distribution of Participants (n = 40)

Leg Dominance	Frequency (n)	Percentage (%)
Right	17	42.5%
Left	23	57.5%
Total	**40**	**100%**

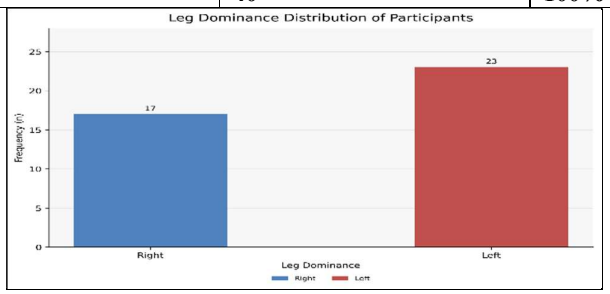


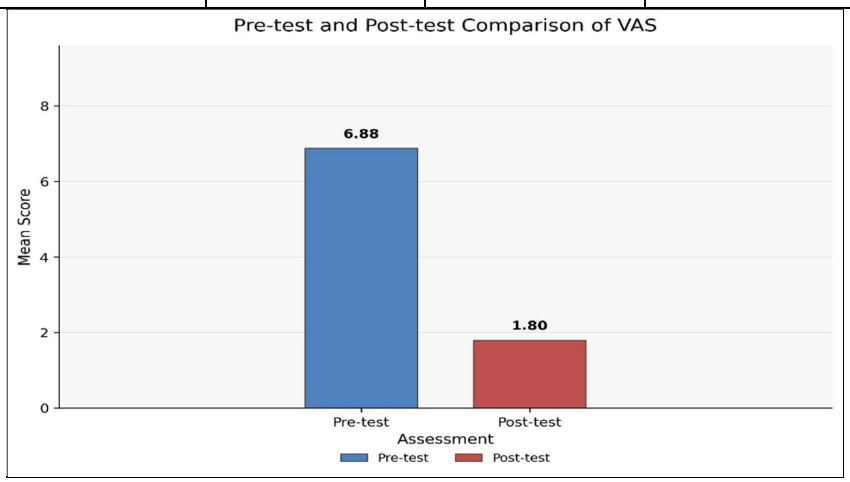
Figure 5: Leg Dominance Distribution of Participants

Interpretation:

The majority of participants, 57.5%, had left leg dominance, while 42.5% had right leg dominance.

Table 6: VAS Analysis

Outcome Measure	Pre (Mean ± SD)	Post (Mean ± SD)	Mean Difference	t-value	p-value
VAS	6.88 ± 0.94	1.80 ± 0.85	5.08	25.71	< 0.001

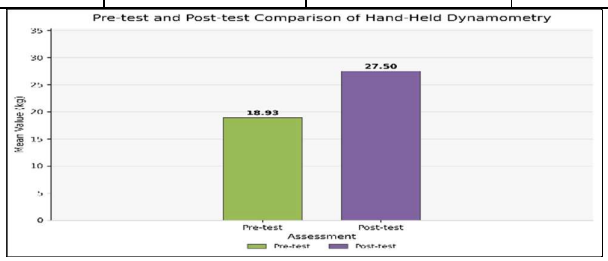


Interpretation:

VAS score showed a highly significant reduction after intervention. The mean score decreased from 6.88 ± 0.94 to 1.80 ± 0.85, indicating marked reduction in shin splint pain after tibialis muscle strengthening exercises.

Table 7: Hand-Held Dynamometry Analysis

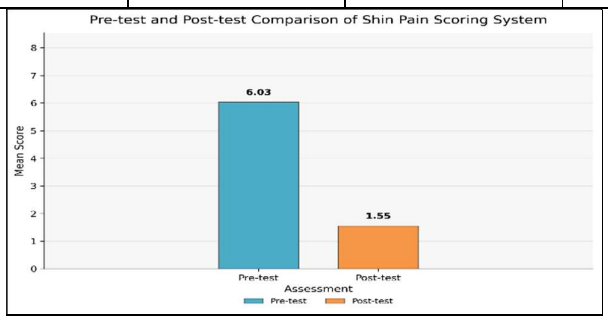
Outcome Measure	Pre (Mean ± SD)	Post (Mean ± SD)	Mean Difference	t-value	p-value
Hand-Held Dynamometry	18.93 ± 3.42 kg	27.50 ± 3.50 kg	8.58 kg	50.06	< 0.001



Interpretation:
Hand-Held Dynamometry showed a highly significant improvement after intervention. The mean value increased from 18.93 ± 3.42 kg to 27.50 ± 3.50 kg, indicating improvement in tibialis muscle strength.

Table 6: Shin Pain Scoring System Analysis

Outcome Measure	Pre (Mean ± SD)	Post (Mean ± SD)	Mean Difference	t-value	p-value
Shin Pain Scoring System	6.03 ± 0.92	1.55 ± 0.50	4.48	26.65	< 0.001



Interpretation:
Shin Pain Scoring System score showed a highly significant reduction after intervention. The mean score decreased from 6.03 ± 0.92 to 1.55 ± 0.50, indicating improvement in functional activity and reduction in shin pain severity.
Final Interpretation for Results Section
Overall interpretation of the results of the study found significant reduction in scores on all three outcome measures (by at least one category—e.g., 1-10 scale). The average visual analogue scale score decreased by an average of four points (from 6.88 ± .94 to 1.80 ± .85). The average handheld dynamometer values increased by an average of eight kilograms (from 18.93 ± 3.42 kg to 27.50 ± 3.50 kg). The average Shin Pain Scoring System (SPSS) value decreased by an average of 4.48 points (from 6.03 ± .92 to 1.55 ± .50). The results of statistical analyses demonstrated highly statistically significant differences between all three outcome measures ($p < .001$). Based upon this data, it is concluded that a structured program of tibialis muscle strengthening will assist with alleviating shin splint pain, improving tibialis muscle strength, and enhancing functional performance of police trainees diagnosed with Medial Tibial Stress Syndrome (MTSS).

DISCUSSION

This investigation evaluated the success of a 6-week strengthening exercise program for the tibialis anterior muscle, and whether it would reduce shin splint pain experienced by police trainees. The findings show that there was a statistically significant change on each of the primary endpoints. evaluated – specifically, decreased pain levels; improved tibialis anterior muscle strength; and decreased functional limitation following the completion of the intervention.

Police trainees routinely engage in activities that place repetitive loads on their legs, such as running, marching, jumping, and/or carrying a heavy load on his/her legs therefore causing cumulative stress to the tibia and the surrounding muscles. MTSS is common among people who engage in high levels of physical activity and/or high-impact activities in a repetitive manner.[1]

The improvement seen in VAS Scores after treatment can be attributed to improved muscle support through enhanced shock absorption and decreased mechanical stress on the tibia, which corresponds to the conventional treatment for MTSS. Conventional treatment consists of rest, ice, anti-inflammatories, physical therapy and orthotic/prosthetic devices, and/or gradual return to sports/activities;[3] however, the addition of strengthening via physical therapy is important in order to treat decreased strength of the muscular structures supporting the tibia.

Improvement in Hand-Held Dynamometry is indicative of an increase in strength of the tibialis posterior muscle following participation in the exercise programme. Hand-Held Dynamometry is a valid and reliable measure of muscle strength before and after intervention.[5]

The reduction in Shin Pain Scoring System score supports the conclusion that there was a positive response to rehabilitation program, as this is a functional measurement scale used to identify changes in severity of pain, degree of functional limitation and progress towards full functional recovery in people who have developed MTSS.[4]

Physical demands on police training students mimic those of military recruits, including running, marching, high-level intensity training and activities that require loads to be carried. Since military recruits commonly report having medial tibial stress syndrome (MTSS), this is applicable to police trainees. [12]

Dysfunction of lower leg muscles can contribute to the presentation of symptoms observed with medial tibial stress syndrome. There are also differences in the structure and function of the tibialis anterior and tibialis posterior muscle groups which indicate that specific strengthening of the tibialis muscles may benefit rehabilitation. [17]

Improvement in functional activities may also be related to foot stability improvements, as well as decreased excessive pronation. Use of short foot exercises and activation of the foot muscles improve medial arch support and improve foot control during running and weight bearing activities. [15]

Neuromuscular training (balance/managing weight) and functional drills (training other muscles) will improve movement control/proper alignment of the lower limbs. Thus, the combination of functional drills (primarily balance drills) with the strength training of tibial muscles may have improved functional ability levels. [19]

In order to provide proper training for police academy students, it is important to identify and correct risk factors (such as sudden and/or excessive increases in training load; incorrect biomechanics; a history of injury; poor conditioning; and weakness in the lower extremities) that contribute to the development of MTSS. [20]

Thus, the evidence presented herein indicates that "tibial" muscle strengthening exercises can be considered a safe, low-cost and effective form of PT to reduce pain from MTSS, increase the strength of tibial muscles and improve function in police academy students.

Conclusion

The results of this research study suggest that a 6-week progressive resistance training program aimed at strengthening the tibialis anterior and tibialis posterior muscles will result in improved functional ability and decreased pain related to tibial stress syndrome (shin splints) among police recruits. Decreases in both the Pain Rating Scale Scores and the Shin Pain Scoring System scores were demonstrated following the completion of the intervention. In addition, the Hand-Held Dynamometry scores all demonstrated decreased levels of pain, increased strength in the tibialis anterior muscle, and improved functioning of the lower extremities.

While there are several possible mechanisms by which the strengthening of the tibialis anterior and tibialis posterior muscles could contribute to rehabilitation of police recruits with shin splints, it appears likely that the increased absorption of impact load in the lower extremities due to strengthened tibialis muscles will improve the stability of the foot and will enhance the recruits' abilities to tolerate training and perceive lower levels of re-injury during high-impact police training.

Acknowledgements

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Ethical Approval

Ethical approval for the present study was obtained from the Institutional Ethics Committee of Krishna Vishwa Vidyapeeth (Deemed to be University), Karad, Maharashtra, India, vide letter no. KVV/IEC/02/2026 dated January 21, 2026.

Conflicts of Interest

We claim that there are no conflicts of interest in the content of this study.

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