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Immediate effect of dry needling with electrical stimulation on hamstring muscle among amateur cricket players with hamstring muscle tightness and low back pain

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Abstract
Abstract: Amateur athletes play with less fitness, they do not receive the necessary training. Injuries can result from this, and low back discomfort is one of the most frequent ones. When the hamstrings are tight, the pelvis rotates backward, changing the curvature of the lumbar spine and placing extra strain on the nearby muscles and ligaments, resulting in back discomfort. An innovative method for treating muscular shortening in patients is dry needling. Percutaneous electrical nerve stimulation (PENS) is a novel analgesic therapy that combines the benefits of both TENS and electro acupuncture.
Method: Thirty four subjects who fulfilled selection criteria included using convenient sampling. Subjects were evaluated for hamstring tightness using passive knee extension test and were evaluated for low back pain using NPRS before and after treatment. Subjects were given trigger point dry needling with electrical stimulation for 10 minutes on hamstring muscle for single session bilaterally.
Result: Statistical Analysis was done using paired t test. Based on the results of the test analysis at 5% significance level, there is a significant statistical reliable difference between the pre & post treatment values with p-value is less than the 5% significance level(< 0.05) in the study and therefore it justifies the improvements in health outcome post intervention.
Conclusion: Dry needling with electrical stimulation is effective in improving hamstring flexibility and reducing low back pain in amateur cricket players.

Keywords: Amateur cricket players, dry needling, electrical stimulation, hamstring tightness, low back pain, trigger points

1. Introduction
Flexibility is an important component of normal biomechanical function. Neuromusculoskeletal problems are caused by poor flexibility. The hamstring muscles are frequently linked to movement dysfunction at the lumbar spine, pelvis, and lower limbs [1]. Hamstring tightness not only causes decreased range of motion, but it can also contribute to a variety of other musculoskeletal issues [2].
In cricket for deceleration during the bowling action's follow through phase, eccentric knee flexor strength is a crucial factor [28]. In cricket overuse and impact injuries are common. Despite a rise in the frequency of cricket injuries, these injuries' severity has decreased over the years, and the recovery period has shrunk significantly. The hamstring strain is now one of the more prevalent injuries. The large number of overs bowled in the previous week is frequently linked to hamstring issues [5]. Cricketers are more likely to sustain hamstring injuries when their hamstrings are less flexible [3].
Although amateur cricketers play with less fitness, they do not receive the necessary training. Injuries can result from this, and low back discomfort is one of the most frequent ones. Ineffective technique and excessive exercise might cause back injury. Everybody has different training requirements. When the hamstrings are tight, the pelvis rotates backward, changing the curvature of the lumbar spine and placing extra strain on the nearby muscles and ligaments, resulting in back discomfort. In cases of aberrant posture that frequently result in low back pain, tight hamstrings may be to blame.

Low back discomfort may be a common problem among recreational or part-time cricketers who play sports without correct warm-ups or levels of conditioning. An injury from sudden running could be more likely if the hamstring muscles are not elastic enough. Low back discomfort is the result of the spine being subjected to repetitive mechanical loading and frequently particular and unusual movements. Any sport's requirements call for mechanical overload in terms of training. At the lumbar spine, this causes a large amount of compressive forces [4].

A number of techniques have been used to treat hamstring tightness and ease low back pain which include foam roller, Bowen technique, suboccipital muscle inhibition, PNF and Dynamic soft tissue mobilisation. All these techniques have proven to be effective [29-32]. In recent years, dry needling a new advance technique has arrived which improves flexibility of hamstring muscle and also reduces the intensity of low back pain 17.

Dry needling is done using fine monofilament needles [6]. Palpation or mechanical stimulation of trigger point by a needle can evoke local twitch response [7]. An innovative method for treating muscular shortening in patients is dry needling. [8] A taut band forms as a result of an aberrant endplate potential brought on by an overabundance of acetylcholine (ACh) release at the neuromuscular junction at the motor endplates. This prolonged sarcomere contractures caused by the increased ACh release at the motor endplate have the potential to cause local ischemia and hypoxia. Local Twitch Responses are what make dry needling most effective. The length and tension of the muscle fibres are altered by an Local Twitch Response, and the A Beta-fibers and other mechanoreceptors are stimulated. Muscle blood flow and oxygenation may be improved by needling. Higher quantities of -endorphin can prevent neurons from releasing SP, which will stop the transmission of pain [9].

Percutaneous electrical nerve stimulation (PENS) is a novel analgesic therapy that combines the benefits of both TENS and electro acupuncture by stimulating peripheral sensory nerves at dermatomal levels corresponding to local pathology using an acupuncture like needle probe which is positioned in the soft tissues and/or muscles [10]. There are various benefits to using the needles as electrodes as opposed to more conventional transcutaneous nerve stimulation (TENS) such as removing the skin's resistance to electrical currents and numerous studies have also shown that this method provides more pain alleviation and functional improvement than TENS. The dorsal root ganglion's central terminals' N-methyl-D-aspartate (NMDA) receptors seem to be crucial in the emergence of central sensitization in connection with chronic inflammatory pain. Electrical activity can alter the expression of NMDA in primary sensory neurons, producing an analgesic effect, according to animal investigation. It has been demonstrated that electrotherapy causes muscles to relax and improves local blood flow [11].

Passive knee extension test

There are no discernible differences between the dominant and nondominant sides in the mean Active and Passive knee extension angles. Extension angles and isokinetic knee extensor muscle strength are positively correlated. It is highly reliable [12].

Numerical pain rating scale (NPRS)

The most widely used form of the ordinal 11-point NPRS has an excellent test-retest reliability (r=.79-.96) and ranges from 0 to 10 pain intensity (0 being no pain to 10 being the most intense). For measuring pain in people, NPRS is frequently utilised [13].

2. Materials and methods

2.1 Materials

- Consent forms.
- Needles (diameter of 0.3 mm and a length of 60 mm).
- Sanitizer.
- Gloves.
- Electrode clips.
- Towel.
- Universal Goniometer.
- Bottle for disposal.
- Electrical Stimulator (BMS DIGI TENS Dual).

2.2 Study Type- Interventional study
2.3 Sampling design- Convenient Sampling
2.4 Sample size-34
2.5 Study population- Amateur Cricket Players
2.6 Study duration- 6 months
2.7 Study setting- Cricket Clubs, Sangli.

2.8 Method of collection

The study was conducted on 34 healthy amateur cricket players of age group of 18 to 35 years who consented to participate in the study. Subjects with Past hamstring injury within last 2 years, lower limb surgical history, history of any lower limb musculoskeletal disorders, recent Spine Surgery, low back pain due to other back pathology, subjects having hypersensitivity, subjects having cardiovascular disorders, subject having phobia of needles, subjects having haemophilia were excluded.

The intervention was explained to subjects and written consent was taken. Pre and post intervention subjects were evaluated for hamstring tightness and low back pain using Passive knee extension test and Numerical Pain rating scale respectively.

2.9 Intervention

Subject was positioned in prone. Muscle was directly located and on palpation painful spots (trigger points) within muscle belly were identified. The skin was examined, cleaned, and then a clean approach was used to implant the needle. Just above the taut band covering the palpable TrP, the needle was introduced into the skin. The therapist's dominant hand employed to hold the mono filament needle, which had a diameter of 0.3 mm and a length of 60 mm. The target muscle was reached after the needle had been injected into the skin tissue and had been travelling through the muscle TrP. Each painful location was needled. Clip electrodes were placed on the needle and electrical stimulation was given for 10 minutes. Throughout the course of treatment session, the frequency was employed at a low level of 1.5Hz and the intensity was increased as per the tolerance of the subject. The stimulation was given in continuous mode with pulse width of 400 micro seconds and Bi Phasic wave form. The treatment was given on hamstring muscle for both the lower limbs.

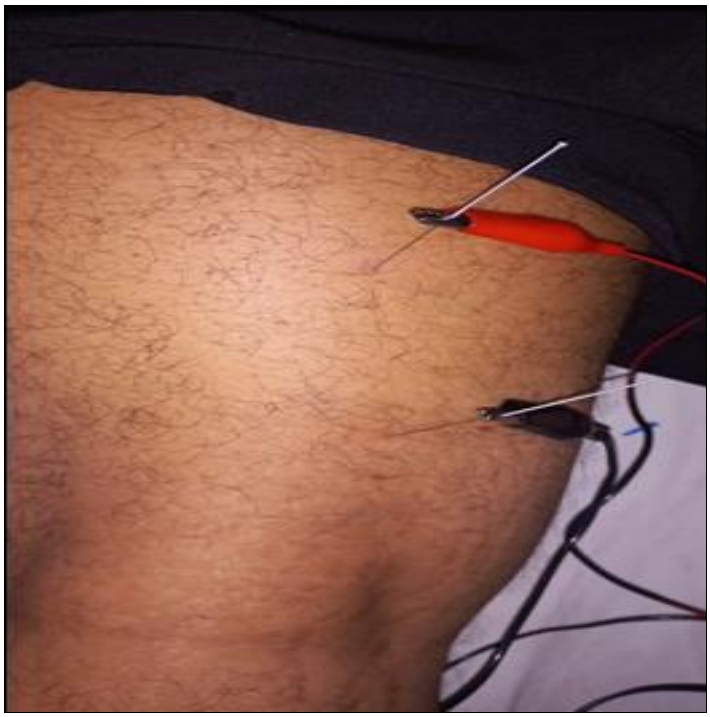


Fig 1: Dry Needling with Electrical Stimulation

2.10 Outcome measures

1. Passive knee extension test (PKET)

Subject was in supine position. Hip and knee were flexed to 90 degree. Subject's knee was passively straightened to a point where subject reported strong but tolerable stretch in their hamstring. Stationary arm was placed along lateral thigh from lateral condyle to greater trochanter, movable arm was placed along lateral fibula in line with fibula head and lateral malleolus. The passive knee extension angle was measured by second examiner using goniometer.

Fig 2: Passive Knee Extension Test

2. Numerical Pain Rating Scale

3. Results and Discussion

Shapiro-Wilks Test for Normality

Variable	Time frame	Z-Value	P-value
PKET Right	Pre	0.898	0.080
	Post	0.989	0.150
	Diff	0.943	0.502
PKET Left	Pre	0.894	0.658
	Post	0.973	0.050
	Diff	0.993	0.053
NPRS	Pre	0.909	0.978
	Post	0.883	0.213
	Diff	0.850	0.179

Data set is normally distributed as all the variables have indicated non-significant outcome in the observation. The researcher shall use parametric test for data analysis purpose in the following sections.

Demographic Information

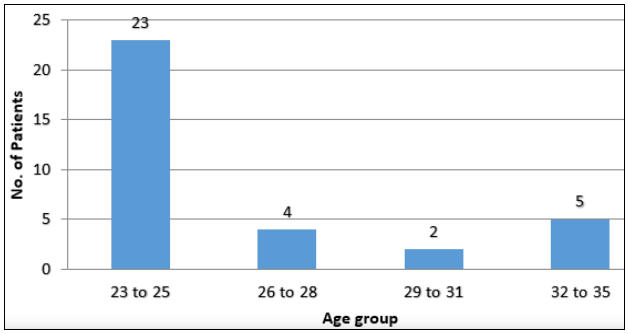
Table 1: Distribution of patients according to Age:

Age group	Frequency	Percent
23 to 25	23	67.6%
26 to 28	4	11.8%
29 to 31	2	5.9%
32 to 35	5	14.7%
Total	34	100%

Source: Primary Data

In this group, maximum number i.e. 23 patients (68%)

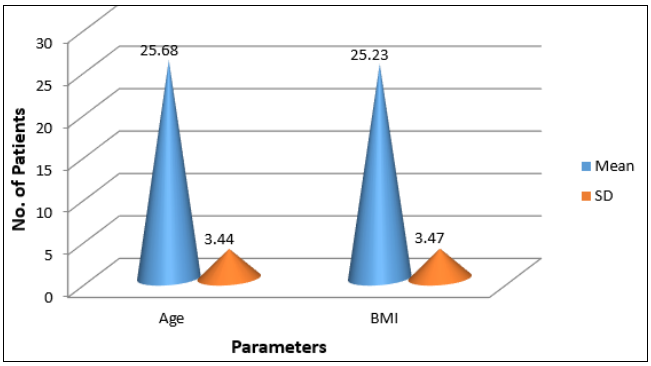
belonged to age group 23 – 25 years, 5 patients (15%) were having age between 32 – 35 years, 4 patients (12%) were seen with age between 26 – 28 years while remaining 2 patients (6%) were seen with age between 29 – 31 years.



Graph 1: Distribution of patient according to Age

Table 2: Descriptive Statistics:

Particular	Minimum	Maximum	Mean	SD
Age	23.00	35.00	25.28	3.44
BMI	16.50	32.60	25.23	3.47



Graph 2: Descriptive Statistics

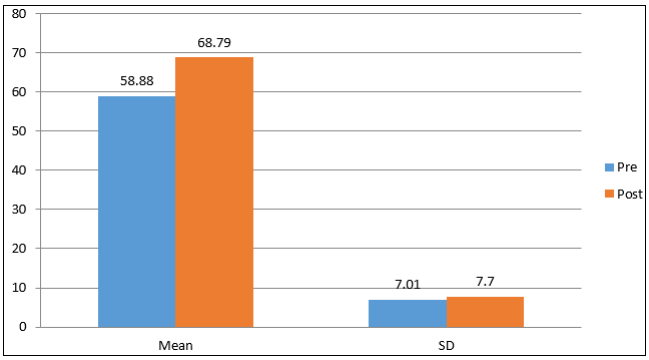
Within group Pre and post test

Comparison of pre-test and post-test PKET Right scores by paired sample t test:

Table 3: Comparison of pre-test and post-test PKET Right scores by paired sample t test

Times	Mean	SD	Mean Diff.	SD Diff.	Effect size	T-Value	P-Value
Pre-test	58.88	7.01	9.91	0.70	3.60	9.94	0.000*
Post-test	68.79	7.70					

The PKET Right mean value indicated changes post treatment and higher values are recorded for post treatment outcome and also the standard deviation shows the consistency with post treatment value which is greater than pre value. The effect size or Cohen's D indicates 3.60 value which is assumed to be very high in effect size as per the standard parameters of reference. Based on the results of the test analysis at 5% significance level, there is a significant statistical reliable difference between the pre & post treatment values with p-value is less than the 5% significance level (i.e. 0.000 < 0.05) in the study and therefore it justifies the improvements in health outcome post intervention



Graph 3: Comparison of pre-test and post-test PKET Right scores

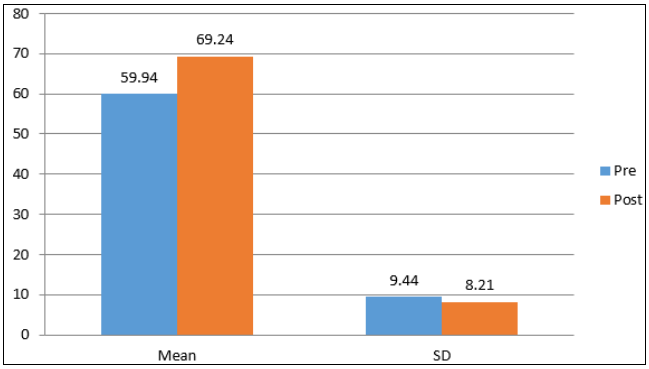
Within group Pre and post test

Comparison of pre-test and post-test PKET Left scores by paired sample t test:

Table 4: Comparison of pre-test and post-test PKET Left scores by paired sample t test

Times	Mean	SD	Mean Diff.	SD Diff.	Effect size	T-Value	P-Value
Pre-test	59.94	9.44	9.29	1.22	4.10	8.28	0.000*
Post-test	69.24	8.21					

The PKET Left mean value indicated changes post treatment and higher values are recorded for post treatment outcome and also the standard deviation shows the consistency with post treatment value which is less than pre value. The effect size or Cohen's D indicates 4.10 values which is assumed to be very high in effect size as per the standard parameters of reference. Based on the results of the test analysis at 5% significance level, there is a significant statistical reliable difference between the pre & post treatment values with p-value is less than the 5% significance level (i.e. 0.000 < 0.05) in the study and therefore it justifies the improvements in health outcome post intervention.



Graph 4: Comparison of pre-test and post-test PKET Left scores

Within group Pre and post test

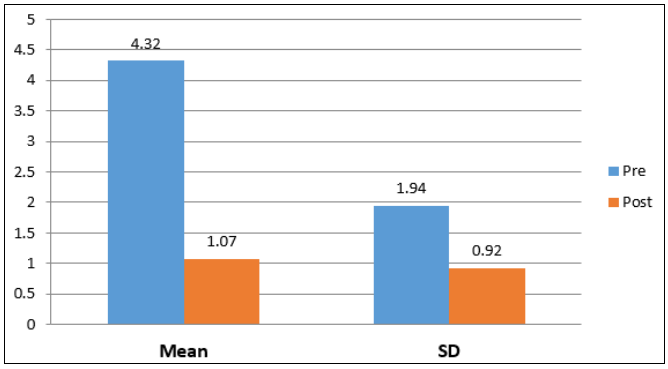
Comparison of pre-test and post-test NPRS scores by paired sample t test:

Table 5: Comparison of pre-test and post-test NPRS scores by paired sample t test

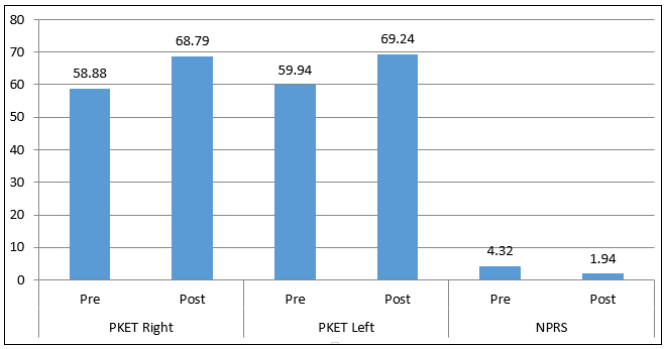
Times	Mean	SD	Mean Diff.	SD Diff.	Effect size	T-Value	P-Value
Pre-test	4.32	1.07	2.38	0.15	6.16	23.00	0.000*
Post-test	1.94	0.92					

The NPRS mean value indicated changes post treatment and lower values are recorded for post treatment outcome and also the standard deviation shows the consistency with post

treatment value which is less than pre value. The effect size or Cohen's D indicates 6.16 value which is assumed to be very high in effect size as per the standard parameters of reference. Based on the results of the test analysis at 5% significance level, there is a significant statistical reliable difference between the pre & post treatment values with p-value is less than the 5% significance level (i.e. 0.000 < 0.05) in the study and therefore it justifies the improvements in health outcome post intervention.



Graph 5: Comparison of pre-test and post-test NPRS scores



Graph 6: Comparison of Mean

The purpose of this study was to find out the immediate effect of dry needling with electrical stimulation on hamstring muscle among amateur cricket players having hamstring tightness and low back pain.

This study was conducted on 34 subjects. Out of total subjects all were male within age group of 23-35 years and were screened according to selection criteria. Subjects were evaluated for hamstring tightness and mechanical low back pain using Passive knee extension test and Numerical pain rating scale. The subjects were given dry needling with electrical stimulation on hamstring muscle for 10 minutes.

The present study demonstrates that hamstring flexibility improved significantly immediately after a single session of dry needling and intensity of mechanical low back was also reduced after single intervention. No serious adverse events occurred with dry needling. Mean age in the study is 25 years and Mean BMI is 25 kg/m^2.

B Arun, MS Nagarajan (2013) did a study on association between hamstrings tightness and low back pain of amateur cricketers. The conclusion was that there was a strong positive correlation (0.913) found between the two variables. An injury from sudden running could be more likely if the hamstring muscles are not elastic enough.[4] According to this previous study the subjects having mechanical low back pain and hamstring tightness were included in the study.

The first objective of this study was to study the immediate effect of dry needling with electrical stimulation on Passive knee extension test for hamstring flexibility. The present study demonstrates significant improvement in hamstring flexibility and it may be due to fact that dry needling enhances blood flow and oxygenation, [18] which may counterbalance persistent muscular shortening caused by contracture. Dry needling may activate the nicotinamide adenine dinucleotide phosphate oxidase 2 (NADPH oxidase), focal adhesion kinase, and extracellular signal related kinase mechano transduction signaling pathways. This enhances the muscles energy metabolism and enables the muscle to grow back to its normal length [19].

Luis Ceballos-Laita *et al*. (2022) did a study to compare the effect of dry needling and self-stretching in muscle extensibility, pain, stiffness, and physical function in hip osteoarthritis. The conclusion of the study was that for patients with hip OA, three sessions of DN were more effective than three weeks of self-stretching in enhancing hip muscular extensibility. Patients with hip OA who used DN and self-stretching methods experienced less pain and stiffness and increased physical function [33].

NN Ansari *et al*. (2018) did a study on immediate effects of dry needling as a novel strategy in healthy subjects and the conclusion was beneficial effects of dry needling should encourage clinicians to use dry needling as a novel strategy for increasing muscle flexibility [8].

Dar, Hicks, G.E.c (2016) investigated the immediate effect of dry needling on lumbar multifidus muscles' function in healthy subjects and concluded that following a dry needling therapy, healthy people showed improved back muscle function and the study suggests that dry needling could amplify muscle activation by stimulating motor nerve fibres [22].

The second objective of this study was to study the immediate effect of dry needling with electrical stimulation on Numerical pain rating scale for mechanical low back pain. The present study shows significant improvement in reducing pain as the dorsal root ganglion's central terminals' N-methyl-D-aspartate (NMDA) receptors seem to be crucial in the emergence of central sensitization in connection with chronic inflammatory pain. Electrical activity can alter the expression of NMDA in primary sensory neurons, producing an analgesic effect. It has been demonstrated that electrotherapy causes muscles to relax and improves local blood flow [11].

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Mahnaz Bazzaz-Yamchi *et al*. (2021) did a study to understand the effects of DN on individuals with LBP who have tight hamstrings. With improvements in hamstring flexibility and function, patients with LBP saw a considerable decrease in pain. After DN and after a week of follow up, the changes in pain intensity were 18% and 48%, immediately

after DN and at one-week follow-up respectively. The conclusion of the study was that a single session of dry needling improved pain and function and increased hamstring flexibility patients with chronic LBP and hamstring tightness [17].

Charles E. Rainey, (2013) did a study on the use of trigger point dry needling and intramuscular electrical stimulation for a subject with chronic low back pain. The study concluded that there is much promise regarding the use of TrP-DN with IES intervention for the treatment of lumbar and/or hip stability dysfunction. Throughout daily activities and functional duties such prolonged sitting, bending over, or lifting objects off the ground, the patient reported no more lumbar and/or posterior hip pain. The individual was able to resume all of her leisure activities and enable her to carry out the requirements of her job. The individual was able to resume all pain-free activities and returned to full military active duty after a two-week follow-up without experiencing any physical limits [11].

Maryam Abbaszadeh-Amirdehi *et al*. (2017) did a study on Therapeutic effects of dry needling in patients with upper trapezius myofascial trigger points and concluded that the sympathetic nervous systems hyperactivity and the irritability of the motor endplate appear to decrease after one session of DN targeting active MTrPs. Deactivating active MTrPs and alleviating symptoms both appear to be accomplished by DN [23].

McLaughlin, Kevin, (2020) did a study on Dry Needling and Intramuscular Electrical Stimulation for a Patient with Chronic Low Back Pain with Movement Coordination Deficits and concluded that Physical therapists may consider dry needling with electrical stimulation when strengthening the multifidus for patients with chronic low back pain and movement coordination deficits [24].

Praveen Kumar, Monika Moitra (2015) did a study to understand the effect of muscle energy technique and PNF stretching in comparison to conventional physiotherapy on hamstring flexibility in chronic non-specific low back pain patients. By enhancing hamstring flexibility in people with low back pain may enable increased pelvic motion around the hip during forward bending, lowering pressures on the posterior structures of the legs and spine and alleviating discomfort. The study concluded that MET, PNF, and static stretching can be used as an efficient therapy strategy to lessen pain, enhance range of motion, and promote hamstring flexibility in chronic low back patients [26-27].

4. Conclusion

The conclusion of the study is that dry needling with electrical stimulation has immediate effect on hamstring tightness and low back pain. It increases range of motion of knee and reduces the intensity of mechanical low back pain in amateur cricket players.

5. Acknowledgments

I take this wonderful opportunity to thank all the “HANDS” which have joined together to make this project a SUCCESS. It’s my great pleasure and privilege to express my deep-felt gratitude to our respected Principal Dr. Aakanksha Joshi and guide Dr. Chintan Solanki who immensely helped me and rendered their advice, precious time, constant encouragement, knowledge and relevant information regarding my study, and whose suggestion and guidance has enlightened me on this subject. I express my sincere thanks to all the teaching & nonteaching staff of the Miraj Medical Centre, College of Physiotherapy. I would like to thank my parents for their blessings, love, constant support, affection and encouragement. Praise and Glory to the God Almighty who is the source of strength, foundation of my knowledge and the source of inspiration in every walk of life.

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Appendix

Ethical clearance letter

Consent form