



Research Article

## EFFECTIVENESS OF SLOW REVERSAL HOLD PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION TECHNIQUE ON ANKLE STABILITY AMONG ADOLESCENT MALE KARATE STUDENTS WITH UNILATERAL ANKLE INSTABILITY

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### ABSTRACT

**Background:** Ankle instability is a common cause for ankle sprains in the players involved in competitive and contact sports such as martial arts. This study has been done using proprioceptive neuromuscular facilitation techniques on improving ankle joint stability in karate players thus preventing ligament sprains.

**Objective:** To find out the effectiveness of slow reversal hold proprioceptive neuromuscular facilitation technique on improving ankle stability in adolescent male karate students with unilateral ankle instability.

**Methods:** Experimental study 30 male karate students with age group of 10-15 years are randomly assigned into two groups (Group-A and Group-B). Karate students in Group-A received Slow reversal hold technique along with routine karate training, while the students in Group-B received only routine karate training. Outcome measures for Ankle stability was evaluated using balance error scoring system. **Results:** Statistical analysis was done by using student's 't' test, which showed significant improvement in the karate students belonging to the Group-A than in karate students of Group-B.

**Conclusion:** Slow reversal hold proprioceptive neuromuscular facilitation technique has shown significant result in improving ankle stability in karate students with unilateral ankle instability.

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### INTRODUCTION

Karate is a stand up and striking martial art that originated in Okinawa, Japan.<sup>1</sup> Karate, one of the martial arts and the word "karate" means empty hand (kara=empty, te=hand) involves the fact that the karate consists of kicks and punches, several techniques to defense without any weapon usage. Karate training has three main aspects; "kohon" are the techniques consist of basics, which can be learnt without an opponent. "kata" consists of techniques used in combination, again practiced and learnt without an opponent. "kumite" is the term used for sparring with an opponent and ranges from prearranged moves for beginners to "free fighting" for experienced practitioners and for use in competitions.<sup>2</sup> Sports and martial arts are learned and increasingly promoted to improve health. Various specialized varieties of martial arts exist, with specific techniques and distinct philosophies. Regardless of popularity, the rate of injuries with practicing martial arts has grown over the recent years.<sup>3</sup> Young adults often sustain injuries, becoming the most commonest in martial arts. Thus these martial arts happens to be a potential health issue.<sup>4</sup> In a study, karate participants younger than 18 years, prevalence of injury risk over a period of 12 months at a rate of 5.6 per 100 athletes.<sup>5</sup> Karate injuries occur from opponents kick (contusions), from falling due to loss of balance (fractures), and from kicking (sprains).<sup>6</sup>

Ankle sprains are most commonly sustained in contact sports, and sports activities involving the jumping activities.<sup>7</sup> Ankle sprains are relatively common occurrence and involve inversion injury to the lateral ankle ligaments as the karate player bears the total bodyweight on the outer edge of the foot. Effective treatment for an ankle sprain is with a rehabilitation protocol; retraining the ankle muscles and enhancing proprioception will prevent future sprains.<sup>8</sup>

Ankle stability is preserved by complex bony arrangements and surrounding soft tissues such as muscles, ligaments, joint proprioceptors. They prevent sudden inversion, eversion foot movements, but they cannot prevent ankle injuries.<sup>9</sup> Musculoskeletal trauma sustained to the ankle are classified as either acute or chronic. Around 85% of all ankle injuries involves the sprain of lateral ankle ligaments. Chronic injuries are often reported due to previous history of sprain and overuse of soft tissues.<sup>7</sup> During the first time of injury to the ankle ligaments can cause mechanical instability, but the associated damage to the musculotendinous and proprioceptive structures can also lead to functional instability with associated neuromuscular dysfunction, thus increasing the future injury risk to the same ankle joint.<sup>10</sup>

The commonest problem encountered by athletic patients is ankle instability.<sup>11</sup> Theories document about the rapid unequal muscular growth during young adulthood which can result in soft tissues laxity and can result in joint injury. It is always recommended to start neuromuscular training during

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adolescence to educate the body, which has rapid growth, decreased balance and coordination.<sup>12,13</sup>

Proprioceptive neuromuscular facilitation technique is an approach to the therapeutic exercise designed to evoke motor responses and improve neuromuscular control and function developed by Kabat, Knott. These techniques can be used to develop muscular strength and endurance; to facilitate stability, mobility, neuromuscular control and coordination of movements and restoration of function. Slow reversal hold technique comprises of isotonic concentric contraction of a stronger agonist muscle spontaneously followed by isotonic concentric contraction of weaker antagonistic pattern. The patterns are provided with no voluntary relaxation.<sup>14</sup>

## METHODS

### *Study Design and Sample*

This is an experimental type of study done for 6 weeks in phoenix karate trust, Sithalapakkam, Chennai, India and masters zone academy, Madipakkam, Chennai, India. about 30 karate students were evaluated for ankle instability in their non-dominant foot and clearly explained about the procedure and informed consent was obtained and explained them that the information obtained will be kept confidential.

Male karate students between 10 to 15 years, with active participation in karate for minimum 2 years were included in the study. The karate students with recent history of fractures in lower limb, head injury, foot deformities, vestibular disorders were excluded from participating in the study.

The students were evaluated using the Balance Error Scoring System (BESS), which has excellent interrater reliability (ICC=0.78-0.96).<sup>15</sup> The BESS score of all karate students was considered as the pre-test score. They were randomly assigned into two groups, Group-A and Group-B.

### *Procedure*

Group-A and Group-B followed a routine karate training program for 2 hours, twice a week. After the warm up exercises, Group-A received the slow reversal hold technique which was applied to the ankle joint muscles of the non-dominant foot (plantar flexors –dorsiflexors),(evertors-invertors) in 3 sets, each set consisting of 5 repetitions, whereas Group-B received only routine karate training.<sup>16</sup>

Group-A karate students were positioned in comfortable long-sitting position with back support. The karate students were explained about the technique and direction of foot movements. The manual resistance was applied to the direction of the foot movement with verbal commands to reverse the movement direction.

At the end of 6 weeks, the karate students were again evaluated using Balance Error Scoring System, considered as the post test score.

### *Balance Error Scoring System*

Balance error scoring system was used to evaluate ankle stability. The test was performed two times: at the beginning and end of 6 weeks training. 20-seconds balance tests were the component of test procedure which the subject had performed in single leg stance (non dominant) foot in two different surfaces (firm and foam). Timing was noted with help of a stopwatch. Karate students were directed to stand in the single

leg stance with their hands on their iliac crests and the actual test began as soon as they closed their eyes. Before the actual pre- test, subjects were allowed to adapt themselves to the firm and foam surfaces. Then karate students were positioned in single leg stance. The non –dominant leg was determined, by which student would not probably use to kick a ball. The dominant leg was lifted above the ground, with 30 degree of hip flexion and knee to 90 degree of flexion. Karate students were directed not to open their eyes and with hands on their hips. Then the students were provided two trails before the actual pre –test. During the testing sessions, the clock was not stopped anywhere during 20 seconds test. If the student had moved from the testing position, he must return to the same position. The error scores obtained in the single leg stance was summed to obtain total BESS score. During the testing procedure, the students were positioned away from the examiner, so that any error movements could be observed.

Types of errors in balance error scoring system:

- Hands moved out of the hip
- Opening the eyes
- Step stumble or fall
- More than 30 degrees of flexion or abduction of hip.
- Lifting the forefoot or heel away from the testing surface
- Failing to remain in the proper testing position for greater than 5 seconds

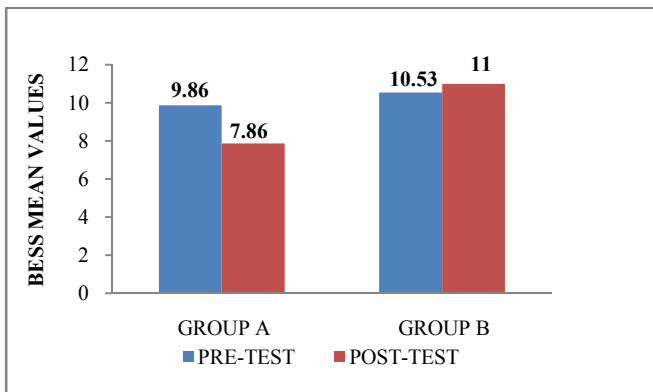
The highest total number of errors for single leg stance is a score of 10.<sup>1</sup>

## RESULTS

From the 30 students analysed for ankle instability and all of them were willing to participate in the study the pre and post test values are tabulated in the table 1 the pre-test mean value of balance error system of karate students in Group-A is 9.86 and the post-test mean value is 7.86, which has significant difference of 0.003. While the karate students in Group-B receiving only the karate training showed pre-test value of 10.53 and post-test mean value of 11.00, in which the improvement is non –significant with value of 0.290. Thus there was a significant difference (p< 0.05) and improvement in mean values of balance error scoring system of karate students belonging to the Group-A receiving slow reversal hold technique whereas, there was no significant changes observed (p>0.05) and a decline in balance error scoring system was noted among the students in Group-B.

**Table 1** shows pre-test and post-test mean values of balance error scoring system among group-a trained with slow reversal hold proprioceptive neuromuscular technique and regular karate training technique and group-b who underwent only regular karate training (n=30)

Groups	Test	Mean	N	SD	T	df	Sig.(2-tailed)
Group-A	Pre-Test	9.86	15	3.22638	3.623	14	0.00
	Post-Test	7.86		2.55976			
Group-B	Pre-Test	10.53	15	3.33524	-1.101	14	0.29
	Post-Test	11.00		3.18479			



**Graph 1** Pre-test and post-test mean values of balance error scoring system among group-a trained with slow reversal hold proprioceptive neuromuscular technique and regular karate training technique and group-b who underwent only regular karate training (n=30)

## DISCUSSION

This study determines the effectiveness of slow reversal hold proprioceptive neuromuscular facilitation technique on ankle stability among adolescent male karate students with unilateral ankle instability.

About 67% of male karate students sustained about more of lower limb sprains (8%) which acts a requisite for the study.<sup>3</sup> While interpreting in testing position for 20-seconds, both the groups did commit errors mainly such as opening the eyes and keeping dominant leg on the ground while performing single leg stance. However the number of errors was much reduced in the firm surface and fairly higher in performing on foam surface indicating ankle instability.

The results of this study shows that there was a statistical difference only in the Group-A ( $p$  value < 0.05) when pre and post test was compared, depicting improved ankle stability and there was insignificance in values of balance error scoring system scores of students in Group-B, which has reported due to the muscle fatigue around ankle joint of the tested foot after karate training. Thus there is increase in ankle stability only in Group-A karate students.

The improvement in ankle stability can be better explained by the fact that Proprioceptive neuromuscular training facilitates the joint muscle activation, resulting in stiffness and active stability. Thus a resultant increase in balance and stability, which safeguards the soft tissue structures from future injuries.<sup>18</sup> This technique also indirectly strengthens muscles around the ankle joint which can be explained by the fact that Strengthening technique starts with overlapping of filaments in a sarcomere of a muscle fiber during an isotonic muscular contraction which results in the shortening of muscle fibres due to cross-over of thick and thin filaments in sarcomere.

There was a statistically significant improvement in ankle stability among Group A karate students than Group-B karate students ( $p < 0.05$ ) which shows that proprioceptive neuromuscular facilitation training for a period of 6 weeks has a better effect in improving ankle stability among karate students.

There is no increase in muscle bulk after training with proprioceptive neuromuscular training in the initial period of exercise and the changes in muscle bulk is observed only after training for a period of 6-8 weeks and it is documented that muscle is activated only in this period and as a consequence of changes in neural drive, the muscle strength increases.<sup>19</sup>

When training with proprioceptive neuromuscular facilitation exercises, the proprioceptors, mechanoreceptors within the muscles, tendons are activated faster in effective manner and reduction in time between the neural stimuli and muscular response occurs.<sup>20</sup> Slow reversal hold technique works on equalizing the muscle power within weaker and stronger agonist-antagonist muscle group. When the isometric holding is provided to weaker muscle group at the end of isotonic contraction, it works through reciprocal inhibition thus relaxing the stronger antagonist muscle group and further strengthens the weaker antagonist muscle.

Though the equality in strength between muscle groups is achieved and there is resultant joint stiffness and stability, but cannot prevent injury as it is sudden forceful mechanism, but this study supports the fact that proprioceptive neuromuscular training can reduce the severity of injury among adolescent karate players which may indirectly help them perform better in sports.

## CONCLUSION

This study concludes that slow reversal hold proprioceptive neuromuscular facilitation technique on the adolescent male karate students for six weeks along with karate training has better improvement of ankle stability. Thus slow reversal hold technique can benefit the players and can be recommended in the treatment of the ankle instability among karate players.

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