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Effectiveness of Sensory Integration and Conventional Therapy on Impaired Kinesthesia in Peripheral Neuropathy

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Abstract

Background: Peripheral neuropathy is a result of damage to the nerves located outside of the brain and spinal cord. Over all prevalence in India varies from 5 - 2400 per 10,000 populations. Diabetic neuropathy is the most common type. Kinesthesia is the ability to sense the motion of a joint or limb. It is primarily influenced by muscle spindles and secondarily influenced by skin receptors and joint receptors. **Objectives:** To determine the effectiveness of sensory integration on kinesthesia in peripheral neuropathy and to compare the effect of sensory integration with conventional therapy on kinesthesia in peripheral neuropathy. **Materials And Methods:** This was an experimental study conducted on 68 subjects in which Group A received conventional therapy (control) and another group received sensory integration along with conventional therapy (experimental). Simple Random Sampling technique was used. Pre intervention assessment was done and treatment was given for 6 weeks. Post intervention assessment was done with help of outcome measures. Statistical analysis was done using students t test. **Results:**Among the 68 subjects, Group B which received sensory integration along with conventional therapy showed extremely significant improvement in impaired kinesthesia. In the Weber two point discrimination test, the post intervention comparison (8.6 with group A and 5.98 with group B) showed that group was extremely significant in improving joint position sense. In joint position sense for plantar flexion and dorsiflexion, Group B showed extremely proximate results to range which was asked and the range which was performed by the subjects. **Conclusion:** Sensory integration therapy was found to be significantly effective on impaired kinesthesia in peripheral neuropathy.

Keywords: Conventional Exercises, Kinesthesia, Peripheral Neuropathy, Sensory Integration

1. Introduction

Peripheral neuropathy is a result of damage to the nerves located outside the brain and spinal cord. It is miscellaneous in etiology and pathology with varied nature in severity. This term includes symmetric polyneuropathy, single and multiple mononeuropathy, and radiculopathy[1]. Peripheral neuropathy often causes pain, numbness and weakness. This is characteristically seen in hands and feet. It can also affect digestion, circulation and urination. Peripheral nervous system carries information from brain and spinal cord to the rest of body. It also sends information from distal to the central nervous system. The most common cause is diabetes, immune mediated conditions, exposure to chemotherapy and exposure to toxins like alcohol[2]. Diagnosing neuropathies is very challenging due to its diversified presentation and causes. A complete clinical history with examination, nerve conduction studies, and various laboratory tests are required to identify causes. It is common in all age groups but the effectincreases in older age groups. Identification of exact cause is important in order to identify correct treatment measures. For example, almost every 10th patient suffers from a polyneuropathy of autoimmune origin[3]. Therefore, this cannot be obliterated while management. Causes have been shown to be different in various geographical distributions. Studies conducted in Norway and Netherlands identified unique causes which includes Vasculitic, amyloid neuropathy, sarcoid, connective tissue diseases, Uremic, thyroid dysfunction besides Vitamin B 12 deficiency, Inflammatory/Immune-mediated and Idiopathic axonal.

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The progression of peripheral neuropathy includes various patterns of symptoms which varies from person to person. In most of the cases it begins with numbness and pain which is inconsistent, later the symptoms become more common, followed by the pain reaching new heights, followed by constant numbness which may progress to the total loss of sensation. Stocking and glove distribution is classically seen. Sometimes only one nerve may be involved (mononeuropathy). Neuropathy in which two or more nerves in different areas are affected is called multiple mononeuropathy or mononeuropathy multiplex.

Peripheral nerves are of three types: sensory, motor and mixed. Some neuropathies affect all three of nerves while others may involve one or two. Common examples are bell's palsy, peroneal nerve palsy, carpel tunnel syndrome, ulnar nerve palsy, post herpetic neuralgia. In sensory neuropathy- pins and needle sensations, decreased sensation to vibration and touch, increased pain, loss of ability to detect cold and hot is seen. Motor neuropathy may present with muscle weakness, wasting, twitching with cramps and shrinking. In autonomic neuropathy, problems with heat intolerance, sweating, blood pressure and swallowing is seen.

Kinesthetic sensation or joint sensation and movement of limbs has been a subject of surmise for more than 400 years[4]. It is defined as awareness of the position and movement of the parts of the body by means of sensory organs (proprioceptors) in the muscles and joints. It is a function through which we can tell where our body parts are located even when our eyes are closed or when we are not looking at our body. It is basically controlled by muscle spindles, joint and skin receptors. According to the hypothesis by Yin[5], basal ganglia control the speed of movement through kinaesthetic reafferent input. The entire nervous system is responsible for kinesthetic sense. Kinesthesia is important component in muscle memory and coordination. Kinesthetic learning animates actions, facilitates analytic, social and psychological development, speeds up the brain's capacity to memorize information, and develops capacities, strengths and self-confidence. Kinesthesia is measured as the smallest change in joint angle required eliciting conscious awareness of joint motion. Uncoordinated movement, clumsiness, poor postural control are common symptoms of impaired kinesthesia. Ataxia and kinesthetic loss are common in advanced cases[6]. In majority of diabetic subjects, proprioception is intact but kinesthetic sensations are commonly lost[7]. Older subjects have impaired ability to stabilize their body. Central motor programs are necessary for correct kinesthetic ability. Any problem in the feedback makes it unable to sub serve accurate motor control[8]. Environmental factors like reduce temperatures or cryotherapy can influence kinaesthesia as well as sensory-motor function[9]. Joint position sense is important to maintain stability.

Rehabilitation of impaired kinesthesia includes use of different textures, shapes, weight in order to assist sensory reeducation. To integrate proprioception balance training is used. Repetitive practice with dual task training, proprioceptive training, somato-sensory stimulation is frequently practiced. Variety of conventional exercises can be used which challenges the system to improve kinesthetic problems. Sensory integration refers to the processing, integration, and organisation of sensory information from the body and the environment. Problems in integration are very coomon in neuropathies. In physiotherapy management we mostly concentrate on neuropathic pain, weakness but neglect proprioceptive problems. Identifying them and treating at right time is very important to avoid progression as well as complications of the disease.

2. Materials and Methods

Study Type: Experimental study.

Sampling Technique: Simple Random Sampling. A total of 68 subjects diagnosed with peripheral neuropathy and impaired kinesthesia participated in this study. Age was between 18-35. Subjects with medications for any systemic illnesses were excluded. The objectives of the study were clearly explained to them. They were to see the effect of sensory integration on kinesthesia in peripheral neuropathy and to compare the effect of sensory integration with conventional therapy on kinesthesia in peripheral neuropathy.

Outcome Measures: Weber two point discrimination test- It is most common test use to asses used to of assess sensibility of the upper extremity. Two point discrimination is the ability to spot two nearby objects touching the skin at truly two distinct points. In this test two sharp points are used. It is widely used to asses tactile perception. It should be completed with eyes closed[10]. We used paper clip and two point discriminator to evaluate the subjects[11]. Normal discrimination recognition is less than 6mm, but it is different from person to person.

Joint Position Sense: It is the information which the brain receives from different sources like joints and muscle receptors, cutaneous afferents[12]. Assessment was performed in the sitting position. Ankle goniometer was placed just below the tip of the lateral malleoli and arms were aligned along fibular head and fifth metatarsal prominence and were fixed with tape. Starting position of ankle was at 90 degrees. The ankle was moved passively with eyes closed and then the subject was asked to perform it will the target ankle. Total range of motion for both the movements was measured.

Procedure: After getting ethical approval from institutional ethical committee, subjects were included as per the selection criteria. The procedure was thoroughly explained

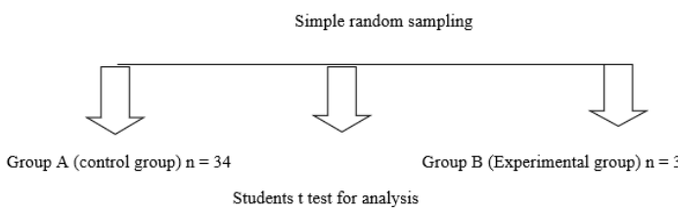
to the subjects and written consent was taken. Pre intervention assessment was done using outcome measures. The subjects were told about do's and don'ts, types of clothing to be worn, timings of medicine and food to be taken if any, stopping the treatment whenever any problem arises etc. Subjects were divided into two groups- control and experimental using simple random sampling technique. Intervention was given for 6 weeks. Post intervention assessment was done. Statistical analysis was carried out to find out the results and finding the level of significance using student t-test.

Group A- control group conventional therapy included education, proprioceptive training exercises, balance training, dual task training and biofeedback. Each session was 45-50 minutes. Home exercises were also given.

Group B- Experimental group included conventional exercises along with sensory integration. Exercises like proprioceptive activities, deep pressure activities, and vestibular sensory integration activities on joints were practiced. Progressively exercises were made challenging. Every session was for 45-50 minutes. Self practice exercises were told.

2.1 Statistical Analysis

Total number of subjects 68



Statistical analysis was done manually by using the statistics software's SPSS version 16.0.

3. Results

In this study, subjects were divided into two groups. Group A received conventional thearapy and group B received Sensory integration along with conventional therapy. Sex distribution of subjects included is presented in Figure 1. Treatment outcome were analyzed within and between the groups. Changes for Two point discrimination within the groups are presented in Figure 2 (Group A) and Figure 3 (Group B). To evaluate the changes and find out which treatment is better, between the group analyses was done using unpaired T test. It is presented in Figure 4. Sensory integration along with conventional therapy shows significant improvement in it. Joint position sense of plantar flexion and dorsi-flexion was taken and analysis was done. Figure 5 (Group A) and Figure 6 (Group B) represents changes within the group for plantar flexion sensation. Figure 7 represents changes between the groups which show that sensory integration therapy shows significant improvement in improving plantar-flexion joint sense. Dorsiflexion joint sensation was also evaluated and effects of treatments were seen. Figure 8 (Group A) and Figure 9 (Group B) shows changes pre and post treatment changes within the respective groups. Between the groups analysis was done and is presented in Figure 10 which shows significant improvement with sensory integration along with conventional therapy.

Among 68 subjects, 36 were male (52.9%) and 32 were females (47.05%).

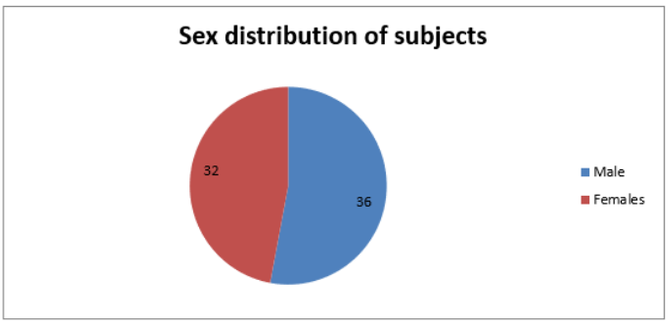
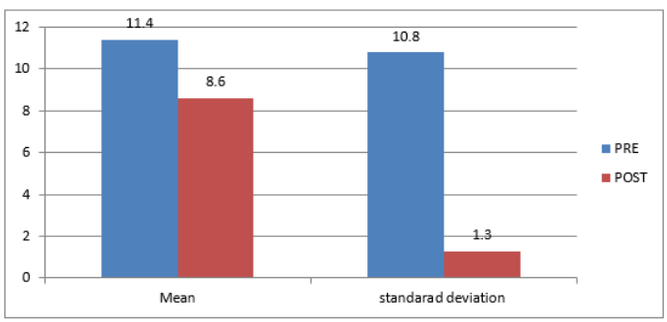


Figure 1. Sex distribution of subjects.

3.1 Weber Two Point Discrimination Test

3.1.1 Within Group Comparison: (Paired t test)

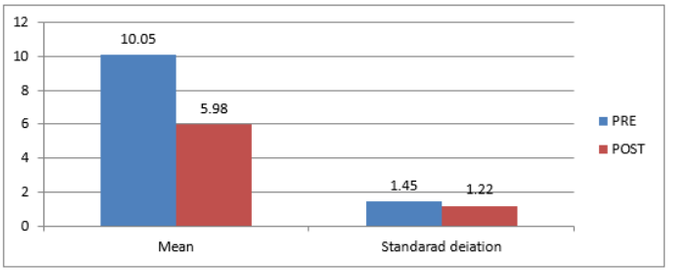
Group A: Control group (conventional therapy)



P<0.001 considered significant with t = 2.177

Figure 2. Comparison of pre and post changes within Group A (Conventional Therapy).

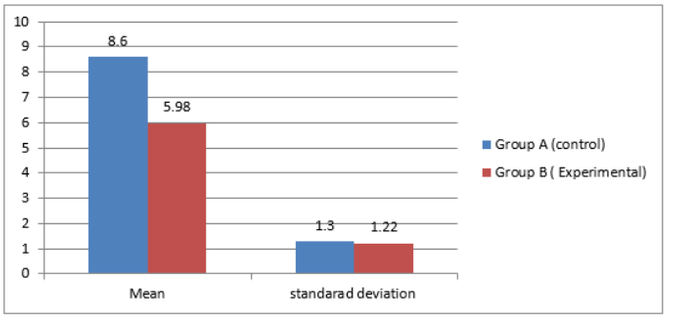
Group B Experimental group (Sensory integration along with conventional therapy)



P<0.001 considered extremely significant with t= 17.64

Figure 3. Comparison of pre and post changes within Group B (sensory integration along with conventional therapy).

3.1.2 Between Group Comparison: (Unpaired t test)



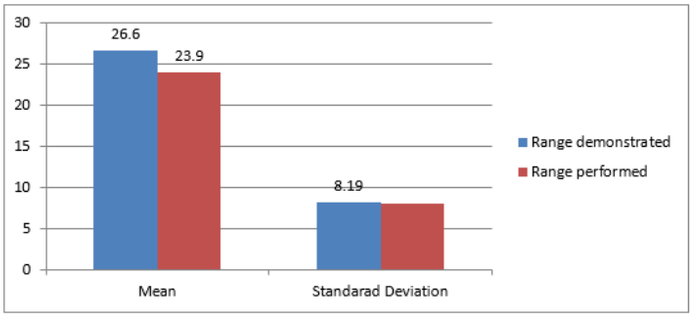
P<0.001 considered extremely significant with t= 12.12

Figure 4. Between group comparison of control and experimental group.

3.2 Joint Position Sense (Plantar flexion)

3.2.1 Within Group Comparison: (Paired t test)

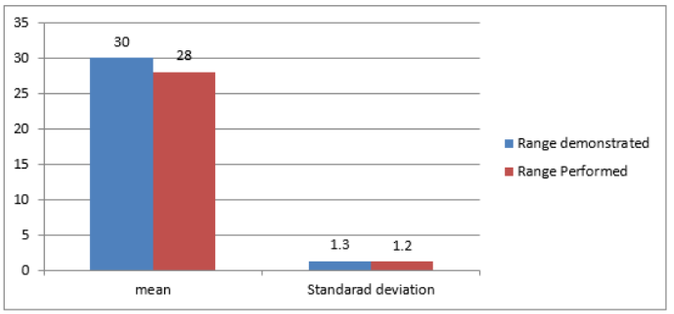
Group A: Control group (conventional therapy)



P<0.001 considered significant

Figure 5. Comparison of range demonstrated and range performed in Group A (conventional therapy).

Group B: Experimental group B (Sensory integration along with conventional therapy)



P<0.001 considered extremely significant

Figure 6. Comparison of range demonstrated and range performed in Group B (sensory integration along with conventional therapy).

3.2.2 Between Group Comparisons

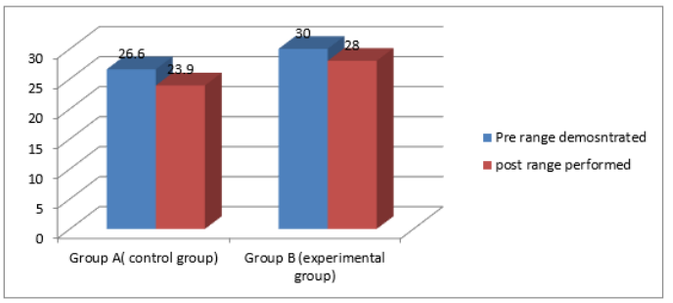
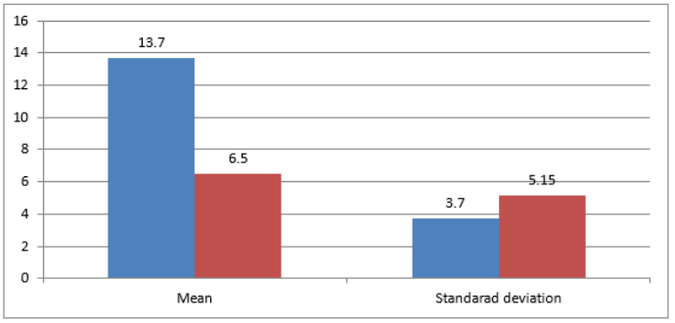


Figure 7. Between group comparison of control and experimental group of prange demonstrated and range performed. Group B shows significant improvement.

3.3 Joint Position Sense (Dorsi flexion)

3.3.1 Within Group Comparison: (Paired t test)

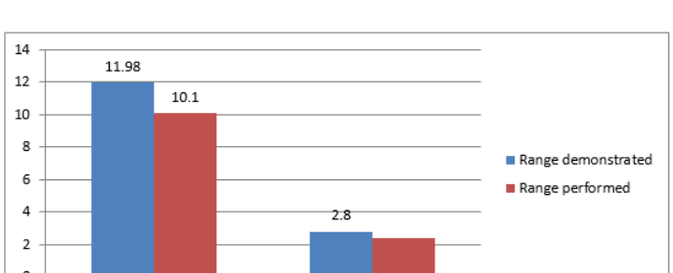
Group A: Control group (conventional therapy)



P<0.0001 considered significant with t= 10.98

Figure 8. Comparison of pre and post changes within Group A (conventional therapy).

Group B: Experimental group B (Sensory integration along with conventional therapy)



P<0.0001 considered extremely significant with t= 9.005

Figure 9. Comparison of pre and post changes within Group B (sensory integration along with conventional therapy).

3.3.2 Between Group Comparison

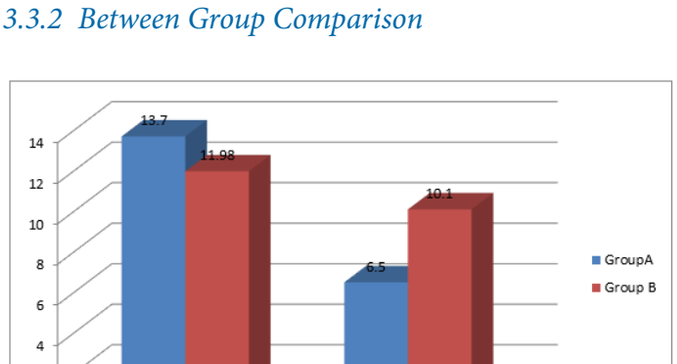


Figure 10. Between group comparison of control and experimental group of pre range demonstrated and range performed. Group B shows extremely significant improvement.

4. Discussion

A study on Effectiveness of Sensory Integration and Conventional Therapy on Impaired Kinesthesia in Peripheral Neuropathy was conducted to see the influence of sensory integration techniques and conventional approaches on impaired kinesthesia. It was conducted on subjects diagnosed with peripheral neuropathy having impaired kinesthesia. The sample size was 68 (36 males and 32 females).

Prevalence of neuropathy in India was very high in subjects with recently diagnosed type 2 diabetes mellitus[13]. The goal of management is to prolong independency and safety in ambulation. Various disciplines are involved in treatment[14].

4.1 Conventional Exercises

Resisted exercises of upper and lower limb are useful to maintain strength in muscles and joints. It moderately improves strength[15]. Endurance training has been shown to have a positive impact on balance and quality of life[16]. These exercises focus on overall symptoms but are lacking on specificity which might have been the cause for slower improvement. Conventional Weight bearing exercises for wrist and ankle joints are necessary for intersegment coordination and have shown improvement in mobility. But subjects should be first trained for normal sensiromotor enhancement. Open and closed chain exercises put stress on joints and aggravate pain so it should be properly implemented[17]. Aerobic exercises are targeted on cardiac conditioning. Various forms like swimming, cycling, walking etc keeps the arteries strong. It increases the stamina and reduces stress. It has shown to play a valuable role to halt the progression of diabetes ploy neuropathy[18]. But their role on proprioception and kinesthesia still requires further approaches. Postural training has shown improvement in lung capacity, reduces pain, and improves circulation and digestion. It has a direct effect on mobility and flexibility. Strengthening exercises is useful in maintaining muscle tissues, bone strength, minimize fat. Such forms of exercises have been shown to improve quality of life in neuropathies. Lower limb speed of strength generation has been shown to improve by resisted training[19]. Electrical stimulation has been shown to have limited effect on numbness secondary to neuropathy. This raises the question on limited use of electrical agents on sensory dysfunctions in various diseases.

4.2 Sensory Integration Exercises

Sensory integration is a form of exercise which helps the subject to consolidate and process sensory information from the environment effectively. Sensory processing is important for daily functioning. It is useful in reorganizing, adapting and gradual mastering the skills. Sensory integration has shown to significantly improve joint sensation in subjects having numbness and tingling. It has taught to facilitate neural circuits there by creating awareness about the position sense in disturbed kinesthesia. These exercises have improved by re-education of perception within the joints and muscle fibers. Training of identification of shapes by using various textures must have helped in training. Compensatory mechanisms in decreased sensation, utilization of affected part to receive tactile stimulus must have helped in regaining the sense of position. Setting of specific goals and mechanism to achieve those are important concepts of this therapy[20] which must have helped the subjects achieve joint position sense. Sensory stimulation has shown to facilitate activities in traumatic brain injury patients. Texture handling, temperature differentiation, sensory locating, proprioceptive training, pressure and grip training have been found to be effective tools in rehabilitation.

Combining conventional approaches with sensory integration has helped in modulation of sensory systems. It has maximized functional ability and entire motor planning ability within the joints and muscles. Facilitation of sensory receptors is achieved which assists in creating awareness of one's body part even with eyes closed. Integration techniques have shown to improve muscle tone and coordination. It has been very effective to cope up with difficulties in processing various sensory inputs. Sensory integration focuses on proprioceptive, tactile and vestibular system making it more efficient in learning sensation. As sensory processing is integration work of all these systems, akinesthesia has been shown to be very well managed using principles of sensory integration exercises. In Physiotherapy, various physiological approaches in combination of routine exercises have been found to be effective in management of nerve injuries like Gullian Barrie syndrome[21], spinal cord injuries[22] and UMN lesions like Parkinson's disease[23]. Timely intervention with sensory consolidation has shown to improve awareness within muscles and joints. Conventional approaches lack in site and effect relation and interventions are given as a whole irrespective to stage of recovery. This increases the time of recovery. These drawbacks have been compensated by adding sensory integration to routine interventions.

5. Conclusion

The study concluded that, sensory integration approaches have been found to be extremely effective in improving the kinesthetic sensation when added with conventional therapy in peripheral neuropathy.

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