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Original Article

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Effects of Proprioceptive Training on Muscle Strength, Functional Ability and Joint Position Sense in Patients with Knee Osteoarthritis: A Randomized Clinical Trial

Monika Moitra*, Shivani Rehal, Senthil P. Kumar*****

Abstract

Aim: The aim of the study was to evaluate the effectiveness of proprioceptive training on muscle strength, functional Ability and joint position sense in patients with Knee Osteoarthritis. *Methods:* 30 subjects with Knee Osteoarthritis were included and divided into two groups A and B. After pre-test measurements of muscle strength, functional ability and joint position sense group A was given Conservative physiotherapy only and group B was given Proprioceptive Training and Conservative physiotherapy for four days a week for six weeks. Post-test measurements were done after 3 and 6 week. Peak torque, WOMAC, Joint reposition error was used as pre and post outcome measures. *Analysis:* Pre assessment scores and after 3 and 6 weeks post treatment assessment scores were analyzed using unpaired t-test and repeated ANOVA at 95% confidence interval in SPSS version 16 for Windows. *Results:* The analysis revealed that Proprioceptive training with Conservative physiotherapy produced significant improvement. The mean improvement in Experimental group in terms of muscle strength was 67.48 degree, functional ability was 47.21 degree and joint position sense was 43.20 degree after 3 and 6 weeks intervention. *Conclusion:* This intervention is a promising adjunct to the management of the Knee Osteoarthritis.The proprioceptive training offers an effective intervention for knee strength, joint position sense and functional ability of the patients.

Keywords: Knee Osteoarthritis; Proprioceptive Training; Strengthening Exercise; Stretching.

Introduction

Osteoarthritis (OA) is a prevalent, ubiquitous, disabling condition that most often affect the knee joint. The cardinal feature of knee OA includes the pain but the patients also report muscle weakness, instability, fatigue and early morning stiffness [1]. The prevalence of OA increase with age, thus the physiological functions associated with the aging process decreases [2]. The pathophysiological changes in OA involves dehydration & degeneration of both intraarticular and periarticular structures such as articular cartilages subchondral bone, synovial membrane, capsules and ligaments which in turn leads to distraction of mechanoreceptors that manifest as impaired static and dynamic proprioception and kinesthetic sense [3].

The ensuring arthrogenic inhibition also affects the surrounding muscles especially the quadriceps which undergo structural and functional changes leading to altered activation and recruitment patterns. Quadriceps being the primary active stabilizer of the knee [4]. Its changes in OA thus compromises proprioception. The impaired proprioception, decrease muscle strength, restricted joint mobility and pain leads to the accelerate progression of OA that in turn leads to poor functional independence [5].

The number of arthritic persons and the ensuing social impact are projected to increase by 40% in the next 25 years a more global perspective in knee and hip OA prevalence has also been reported by the World Health Organization. In NHANES III, the overall prevalence of knee OA worldwide increased to 37.4% in subjects 60 years of age and older.

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Radiographic evidence of OA increased with age, from 27% in subjects younger than age 70, to 44% in subjects age 80 or older [6]. There was a slightly higher prevalence of radiographic changes of OA in women than in men. The prevalence of osteoarthritis (OA) of the knee in adults, the leading cause of disability is arthritis [7].

In physiotherapy treatment for OA included the use of individual or combined treatments comprising of electrotherapy, exercise therapy and manual therapy. Therapeutic exercise strategies for OA knee were aimed at flexibility, strength, endurance and balance. These interventions were shown to improve proprioception but they were likely to be non-specific to the proprioceptive impairments so the use of specific strategies like proprioceptive training may be necessary to individualize the therapeutic program in knee OA patients.

Methods

Participants

The sample consisted of 30 volunteers, both male and female, with no history of musculoskeletal disease. Their ages ranged from 50 to 70 years. Each volunteer was randomly assigned to group A (Experimental group) and group B (Control group).

Independent variables were Proprioceptive training, Strengthening exercise and Moist heat pack and dependent variable were Muscle strength, Functional ability and Joint position sense Outcome measures were Peak torque, WOMAC and Joint reposition error

Study Protocol

30 subjects of Knee osteoarthritis were selected according to inclusion criteria and allocated with 15 subjects each into group A and B. All the patients received a written explanation of the trial before entry into the study and then gave signed consent to participate. Subject in both the groups were pre-tested by Peak Torque, WOMAC and Joint reposition error. Group A was given only Conservative physiotherapy (Strengthening exercise). It was given for 4 times per week for 6 weeks (total 30 sessions). Group B was given Proprioceptive Training and Conservative physiotherapy. It was given for 4 times per week for 6 weeks (total 24 sessions. For both groups Post-test measurements were done after 3 and 6 weeks.

Proprioceptive Training

1st and 2nd weeks: First phase (Static)

1. Standing upright position (30s) on a firm surface, then on a soft surface (a mat).
2. Single leg stance with closed eyes (first the affected limb, then the non- affected limb) for 10 s on a firm surface, then on a soft surface (a mat).
3. Half-step position for 10 s.
4. One-leg balance for 10 s.

3rd and 4th weeks: Second stage (Dynamic), in addition

1. Forward stepping lunge
2. T-band kicks exercise

5th and 6th weeks: Third phase (Functional), in addition

1. Walking exercise on a firm surface, then on a foam surface

   (a) Toe skipping with toes straight ahead for 20m, toes pointing outward for 20m and toes pointing inward for 20 m.

   (b) Heel skipping with toes straight ahead for 20 m, toes pointing outward for 20m and toes pointing inward for 20 m.
2. Squatting exercise:

   (a) Against a wall and away from the wall.

   (b) One leg squats on the affected and non-affected limb.

Conservative Physiotherapy

Moist Hot Pack

A Moist hot pack will be given after positioning the subjects in each group in long sitting position around the knee joint for 15 minutes for a period of four consecutive days.

Strengthening Training

1st Week

5 min fixed bike exercise without resistance

Range of motion and active stretching exercise applied to hamstring and quadriceps muscles

Quadriceps isometric strengthening exercise

Hamstring muscle isometric exercise.

2nd Week (in addition)

Short arc terminal extension exercise for the knee joint

Isometric exercise for the adductor and abductor muscle of hip joint.

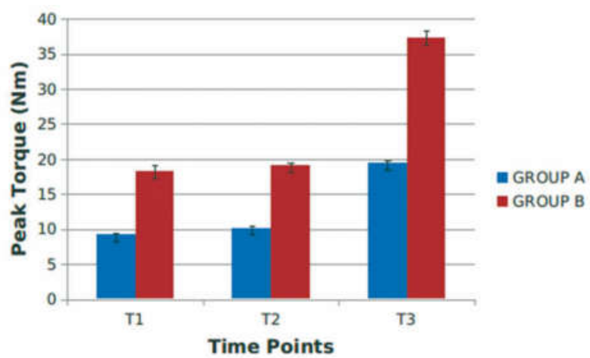
3rd Week (in addition)

Short arc terminal extension exercise with resistance for the knee joint

Isometric strengthening exercise with resistance for the hamstring muscles

Results

The analysis revealed that there was statistically significant difference between pre and post scores in both groups. Group B was showing more improvement than group A at p value < 0.05.



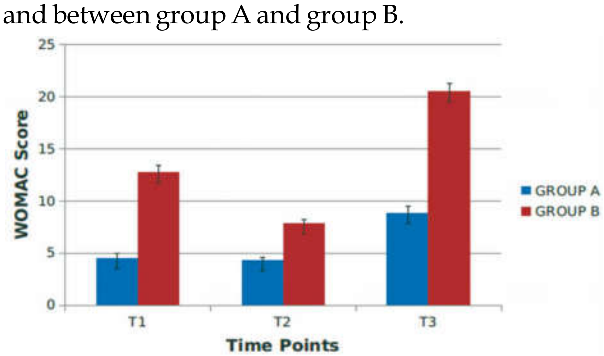
Comparisons of mean difference of peak torque between Group A and Group B

T1 Baseline- 3 Weeks

T2 3- 6Weeks

T3 Baseline- 6 Weeks

The graph above shows values of Peak Torque of among baseline, after 3 weeks and after 6 weeks within and between group A and group B. The mean and standard deviation of group A for was 18.2±0.937 at baseline, at 3 weeks was 19.13±0.363 and at 6 weeks was 37.33±1.013. The mean and standard deviation of group B was 9.2 ±0.175 at baseline, at 3 weeks was 10.2±0.279 and at 6 weeks was 19.4±0.363. Statistical significant difference was found in Peak Torque among baseline, after 3 weeks and after 6 weeks within and between group A and group B.



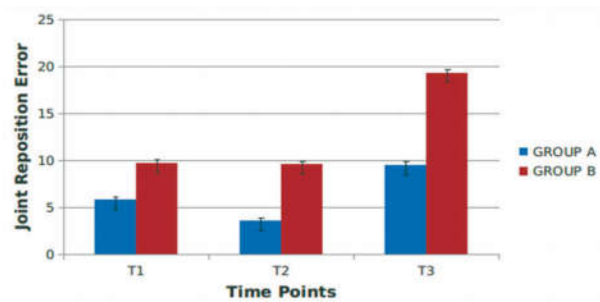
Comparisons of mean difference of WOMAC between Group A and Group B

T1 Baseline-3 Weeks

T2 3- 6 Weeks

T3 Baseline- 6 Weeks

The graph above shows values of WOMAC of among baseline, after 3 weeks and after 6 weeks within and between group A and group B. The mean and standard deviation of group A was 12.73±0.651 at baseline, at 3 weeks was 7.8±0.439and at 6 weeks was 20.53±0.723. The mean and standard deviation of group B was 4.53±0.496 at baseline, at 3 weeks was4.33±0.252 and at 6 weeks was 8.86±0.639. Statistical significant difference was found in WOMAC among baseline, after 3 weeks and after 6 weeks within and between group A and group B.



Comparisons of mean difference of joint reposition error between Group A and Group B

T1 Baseline- 3Weeks

T2 3- 6 Weeks

T3 Baseline- 6 Weeks

The graph above shows values of Absolute Angular Error % of among baseline, after 3 weeks and after 6 weeks within and between group A and group B. The mean and standard deviation of group A was 5.85±0.326 at baseline, at 3 weeks was 3.61± 0.243 and at 6 weeks was 9.47± 0,452. The mean and standard deviation of group B was for was 9.73±0.345 at baseline, at 3 weeks was 9.61±0.33and at 6 weeks was 19.35±0.391. Statistical significant difference was found among baseline, after 3 weeks and after 6 weeks within and between group A and group B.

Discussion

The aim of the study was to compare the effect of proprioceptive training on muscle strength, function ability and joint position sense in knee OA patients. Statistical analysis reveals that Proprioceptive training with Conservative physiotherapy produced significant improvement as evaluated by Peak torque, WOMAC, Joint reposition error after 6 weeks intervention. The results obtained from this study show the efficacy of proprioceptive training in Knee Osteoarthritis. The two groups had equal number of subjects and there were no significant difference with respect to their age, gender which could have altered the results of the study.

The results are supported by study done by Lin et al[8] who conducted a randomized clinical trial to compare the effectiveness of proprioceptive training versus strength training and proprioceptive training led to greater improvements in knee reposition sense.

Panics G et al [9] showed the effect of proprioception training on knee joint position sense and stated its significant effect in improving the joint position sense. Liu-Ambrose et al [10] conduct a randomized clinical trial to see the effect of proprioceptive or strength training on the neuromuscular function.

Esch et al [11] conducted a study in which proprioception was related to functional ability in two ways. First poor proprioception has a weak direct relationship with limitations in functional ability. Poor proprioception is directly related to limitation in functional ability. Second, poor proprioception aggravates the impact of muscle weakness on limitation of functional ability. Results show that poor proprioception has a weak direct relationship with limitations in functional ability.

In the present study the joint position sense, muscle strength and functional ability are measured in Knee OA patients. Results show that in the absence of adequate motor control through a lack of accurate proprioceptive input, muscle weakness affects a patient's functional ability to a greater degree. Study done by Pai et al [12] stated that joint position sense is worse in subjects with Knee OA. These may further lead to functional impairments. Decline in proprioception with age and of further impairment among patients with Knee OA were found.

In this study the Experimental group show improvement in proprioception as measured by Absolute Angular Error % (the changes in the absolute error were 16.97 ± 3.3 experimental Group versus 26.75 ± 2.81 control group). The effect size for all outcome measure are large in between group (d=.8). The analysis reveals that proprioceptive training with Conservative physiotherapy produced significant improvement in experimental group. The mean improvement in Experimental group in terms of muscle strength was 67.48 degree, functional ability was 47.21 degree and joint position sense was 43.20 degree after 3 and 6 weeks intervention.

Conclusion

The results of the study lead us to conclude that Proprioceptive Training with Conservative Physiotherapy proving to be efficient in the treatment of Knee Osteoarthritis than other group which receive only Conservative Physiotherapy. Both the treatment is beneficial for the patients of Knee Osteoarthritis but significant improvement in functional ability, muscle strength and joint position sense was seen in the patients who received Proprioceptive Training with Conservative Physiotherapy. Present study provides scientific evidence for use of Proprioceptive Training in Knee Osteoarthritis so that the treating clinician can choose effective treatment option for Knee Osteoarthritis patients.

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To Evaluate the Efficacy of Dual Task on Gait Parameter in Geriateric Population

Sanjai Kumar*, Meenu Singh, Manish Arora*****

Abstract

Objectives: To evaluate the effects of secondary task (motor/cognitive) on selected spatial and temporal gait parameters in geriatric population? The objective of the study is to describe the effects of motor and cognitive secondary tasks on selected spatial and temporal gait parameters in elderly population. *Subjects:* Fifty (N=50) older subjects (24 women and 26 men), 65-75 years, who meet the inclusion and exclusion criteria were recruited in the study. *Design:* An experimental design study. All tests of all subjects were conducted in the physiotherapy O.P.D. of CSS Hospital, at JAI PHYSIOTHERAPY AND DENTAL CLINIC, SF-06, ANSAL GALLERIA, ANSAL TOWN, MEERUT and in the Physiotherapy OPD of S.B.S. Post Graduate Institute of Bio-Medical Sciences & Research, Balawala, Dehradun. Prior to testing, all the subjects were interviewed about their medical history and had explained the research procedure to them. This information was used to characterize the demographics and health status of subjects participating in the study. Cognition was evaluated by the score of Mini Mental Scale and the balance was evaluated by the Berg's Balance Scale. The participants were asked to perform, in randomized order, the following tasks. Walking alone at their usual speed over a distance of 10 meters and performing a cognitive task, such as loud backword counting from fifty (arithmetic task), and performing a motor task of carrying a plate with full glass of water while walking. Under the dual task condition subjects were not given instruction on speed, to avoid biasing either speed of walk or cognitive response. Before testing, standardized verbal instructions regarding the test procedure with visual demonstration of the walking test was given. Since we were not interested in the potential efforts of the cognitive task on changes in gait dynamics and gait instability and were not necessarily concerned with subjects performance on the cognitive task itself, we did not evaluate performance on the cognitive task.

Each subject completed one trial for all of the testing conditions. The walking trials were realized on a 10 meter walkway in a well lit environment at a self selected speed and wearing their own foot wear. The walkway 9 x 0.5 meter was marked on the floor with two sidelines and the subject was told not to step outside these lines while walking. The subject was followed by a spotter in case of falling. Each walking trial was recorded with a video camera placed on a tripod in front of the walkway; number of steps, number of lateral stepping over and stops were counted and noted from the recording. Time required to complete the 9 meter course was recorded in seconds using a digital stop watch. Participants were given standard instruction to start walking after hearing "Start" and to keep walking until asked to stop. Both the acceleration and deceleration phase of gait were included for analysis. Average gait speed [velocity] was calculated and expressed in centimeter/seconds, the average cadence in number of steps/ minute. The lateral stepping out and stops were counted and expressed in percentage. *Data Analysis*: All analysis were obtained using SPSS windows. Demographic data of subjects including age, Berg's Balance Scale and Mini Mental Scale were descriptively summarized. The dependent variables for statistical analysis were gait cadence, gait velocity, lateral stepping out and stops. One way Multivariate analysis of Variance with repeated measures was performed, to analyze the differences in the gait performances among the three conditions: walking with no task, walking with motor task and walking with cognitive task readings. An α level of 0.05 was used to determine statistical significance. Follow up analysis of variance were conducted if the test demonstrated statistical significance. All possible pair wise post hoc analysis was conducted on the significant dependent variable

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in order to compare difference between conditions. To prevent an inflation of type one error or to maintain á at p=0.05 for this follow up test; a Bonferroni corrected post hoc test was used. *Results:* The results of my study showed that there is a reduction in walking speed for the cognitive performance in Geriatric subjects. *Conclusion:* The results of the study show that elderly subjects attend to do a complex secondary task at the same time as walking, there is a significant dual task interference that compromises the cadence, speed of walking, lateral stepping out and stops. Cognitively demanding activity during walking appears to increase the gait interference more and therefore the type of secondary task was a major determinant of the severity of dual task interference. Performance changes in gait and secondary task when performed simultaneously, confirms that walking is an attention demanding task in elderly population. The results of my study supports the hypothesis, within the limitation of this study. The result of this study provides a base for further research as they presents valuable outcomes for practitioners treating the geriatric population for cognitively demanding activity during gait training.

Keywords: CAD(Cadence); VEL(Velocity); LSO(Lateral Stepping Out) and STP(Stops).

Introduction

The proportion of the population that consists of elderly people is increasing in western as well as in many countries. The individuals 65 years of age and over currently compose 12% of the total US population. This proportion is expected to rise upto 20% by the year 2040. This rapid growth of elderly population has led to an increase in the number older people who experience functional disability. Estimates are that 17% of non institutionalized individuals over the age of 65 years experience some difficulty in performance of basic activities of daily living and instrumental activities of daily living. The likelihood of having difficulty with activities of daily living and instrumental activities of daily living increases as an individual age. 12% of population, 65 to 74 years of age experience difficulty with both activities of daily living and instrumental activities of daily living. This incidence rises to 22% in the 75–84 years old age group and to 4% in those individuals 85 years of age and over [1].

Dual tasking that is engaging in two activities at the same time is common in daily living. During many activities of daily living, people need to perform more than one task at a time. The complexity to do a secondary task(dual task performance) is highly advantageous during walking, because it allows for communication between people, transportation of objects from one location to another and monitoring of environment so that threats to balance can be avoided [2].

Changes of gait characteristics because of a simultaneously performed attention demanding task have been reported frequently among older population. Because of the high prevalence of vision and hearing impairments in older adults, however the association of walking with simultaneous cognitive tasks such as mental arithmetic and motor task such as carrying tray with a glass of water seems to be a more appropriate approach for testing dual task related gait performance of the elderly population [3].

Gait instability is characterized by increased variability from one stride to the next and is common in many older adults; even in absence of pathology. In individuals with neurological pathology, deficits in CNS's ability to coordinate motor outputs are largely responsible for gait instability. In older individuals without apparent neurological pathology, it is not entirely clear why gait instability occurs. Regardless of the cause, gait instability can be quantified [4].

The study of attention or attentional capacity has been a focus of the psychological literature for sometime. One method that has been used to determine the attentional demands of a particular task is called the dual task paradigm. As little, if any, evidence is available with the request to the attentional demand of tasks or procedures used in the clinics, it can be assumed that this methodology has yet to be used in the rehabilitation setting. The dual task methodology requires an individual to perform a task that is being evaluated in terms of its attentional demand (primary task), while simultaneously performing an alternative task (commonly termed as secondary probe task) [5].

Normal aging is characterized by functional changes in the sensory, neurological and musculoskeletal systems. These changes affects several motor tasks. With respect to gait, reduced velocity, shorter steps and slower cadence with advancing age have been reported in healthy elderly [6].

The involvement of attention in the control of the walking – related rhythmic steeping mechanism remains less clear, with only a few and contradictory published results in the literature [7]. Optimal training strategies for dual task performance, in general, and concurrent motor and cognitive tasks, in particular have yet to be determined. No study has been done on secondary motor task interfering gait in healthy elderly, but neurological conditions (Parkinson's disease). Weather secondary motor tasks lead to greater deterioration in gait than secondary cognitive tasks of similar complexity has not been investigated. The literature contains no reports where motor and cognitive secondary tasks were studied within the same investigate.

Aims and Objectives

To evaluate whether the secondary task (motor/ cognitive) on selected spatial and temporal gait parameters would have an effect in geriatric population? The objective of the study is to describe the effects of motor and cognitive secondary tasks on selected spatial and temporal gait parameters in geriatric population.

Operational Defination

Definition of the "Elderly":- The first gerentologic question is, how does a particular segment of population came to be categorized as "Old"? The chronological criterion that is presently used for identifying the old in America is strictly arbitrary and usually has set at 65 years. Because women usually live longer than men, the problems of America's elders are largely the problems of women. The results of several national survey indicate that many of elderly (ranging from 37 to 58%) reports limited or complete inability to carry out activities of daily living. The majority of elderly are women [8].

Gait in the Elderly

A number of investigations have been made of the changes in gait which occur with advancing age. The description which follows is confined to the effects of age on free speed walking although also examined the fast walking [9].

The gait of elderly is subject to two influences – the effects of age itself and the effects of pathological conditions, such as osteoarthritis and parkinsonism, which become more common with advancing age. Providing patients with pathological conditions are carefully excluded, the gait of the elderly appears to be simply a slowed-down version of the gait of younger adults. The author were carefully to point out that 'the walking performance of older men did not resemble a pathological gait' [10].

Dual task paradigm:- The term dual task interference refers to the decrement in performance of one or both tasks when two activities are carried out concurrently. From a widely view point, the degree of dual task interference is a measure of attentional requirements of the component tasks. Extensive evidence documents the decline of performance on one or both activities with engagement in concurrent cognitive and motor tasks. In view of that evidence and the commonness of dual tasking in daily living, procedures to assess and improve dual task performance should be incorporated in fall prevention and rehabilitation programs. Dual task interference occurs when the attentional demands of the two concurrently performed tasks exceed the available capacity. The attentional requirement of performing two tasks simultaneously is the sum of the attentional needs of the component tasks. From that perspective, training aimed at improving dual task performance should include practice in dual tasking. Declines in multiple task performance with age are caused by declines in task coordination [11].

Models of Dual Task Interference

The main theoretical models accounting for dual task interference are :- postponement models, cross talk models, single channel{Bottleneck} theory and capacity/resource sharing model.

Postponement Models:- It proposes that specific cognitive operation can only occurs when a single mechanism is exclusively dedicated to performing that operation for a sufficient period of time.

Cross Talk Models:- According to this theory the task similarity is key factor in successful dual task performance. Similar tasks share the some motor control processing mechanisms and therefore fewer resources are used during simultaneous performance of similar tasks. Cross talk models assume task similarity reduces the dual task interference, because the use of the same pathway increases the efficiency of processing by using less attentional resource capacity.

Single Channel{Bottleneck} theory:- According to this theory of attention, the execution of motor skills involves a mechanism that has limited capacity to process concurrent tasks. The base construct is that tasks are processed in series rather than the parallel. Therefore when a person attempts to consciously control a movement at the same time, the execution of one is compromised. The bottleneck and cross talk models assume that dual task interference is affected by the type of tasks performed simultaneously, rather than the amount of attention needed to sustain performance, when the critical mechanism is occupied with one task, processing operations in the other task that require the mechanism must be postponed until the mechanism becomes available; hence the concept of a processing "bottleneck" or "single channel".

Capacity/Resource Sharing Model:- According to this theory, a central mechanism exists that allocates appropriate attention resources to the performance of the tasks. The major alternative class of models is capacity or resource theories. Finite resources are available; consequently when a demanding primary task is performed like maintaining posture, the secondary task slows, ceases or is performed with greater errors. The allocation of resources change continually according to the resources needed by a given task at a particular time and is graded according to the difficulty of the task. This model allows for the concept of parallel processing. Capacity sharing models are based on the assumption that attention resources are limited.

Hypothesis: Experimental Hypothesis

1. Performing a motor task during alter the temporal and distance parameters of gait in elderly population.
2. Performing a cognitive task during the gait alter the temporal and distance parameters of gait in elderly population.

Null Hypothesis

1. Performing a motor task during does not alter the temporal and distance parameters of gait in elderly population.
2. Performing a cognitive task during the gait does not alter the temporal and distance parameters of gait in elderly population.

Variables

Dependent Variables

1. Cadence (steps/min)
2. Velocity (cm/sec)
3. Lateral Stepping out
4. Frequency In Percentage of Stops

Independent Variables

1. Dual Task
2. Secondary Motor Task
3. Secondary Cognitive Task

Limitation of Study

The small sample size was one of the major limitations of the study. This study has several limitations. The experimental procedure was limited to one cognitive task, counting back the numbers from 100 and one motor task of carrying plate. The generalizability of the present findings to performance of different cognitive and motor tasks is unknown. Investigation of the effects of functional task during gait in more real-world settings during activities of daily living is needed. The data has been restricted to institutionalized older subjects. To fully understand the effect of secondary task performance on gait in geriatric subjects, the effects of various types of skilled, unskilled, complex and simple tasks need to be evaluated. Also, most the participants belonged to the same community. Thus, results obtained cannot be generalized for all geriatric population.

Inclusion Criteria

- Age – 65-75 years.
- Sex – Both males and females.
- Elderly ambulant people without aids.
- Able to understand and follow commands.
- Mini Mental Score – 22 to 30.
- Berg's Balance Scale – 41 to 56.

Exclusion Criteria

- No history of falling.
- No acute medical illness.
- No neurological diagnosis such as Parkinson's disease, stroke, severe dementia, cerebellar disease, myelopathy, myopathy or peripheral neuropathy.
- No psychiatric disorders.
- No major orthopaedic diagnosis including lower back, pelvis or lower extremities and do not use walking aids.

Design

An experimental design study having same subject design undergoing 3 different conditions. The outcom Pre-test and post-test match subject design.

Instruments and Special Testing Tools

The method required very little equipments which includes-

- Digital stop watch
- A measuring tape
- Video Camera
- Chalks to draw the walkway on the floor
- Plate and Glass filled with full water

Materials

Protocol

A sample of (N=50) volunteer participants (N=21), both male and female, age between 65 to 75, were recruited for study. All tests of subjects were conducted in the physiotherapy O.P.D. of CSS Hospital, at Jai Physiotherapy and Dental Clinic, SF-06, Ansal Galleria, Ansal Town, Meerut, and Physiotherapy O.P.D. of S.B.S. Post Graduate Institute of Bio-Medical Sciences & Research, Balawala, Dehradun. Prior to testing, all the subjects were interviewed about their medical history and had explained the research procedure to them. This information was used to characterize the demographics and health status of subjects participating in the study. Cognition was evaluated by the score of Mini Mental Scale and the balance by the Berg's Balance Scale was completed.

The participants were asked to perform, in randomized order the following tasks. Walking alone at their usual speed over a distance of 10 meters and performing a cognitive task, such as loud backword counting from fifty (arithmetic task), and performing a motor task of carrying a plate with full glass of water while walking. Under the dual task condition subjects were not given instruction on speed, to avoid biasing either speed of walk or cognitive response. Before testing, standardized verbal instructions regarding the test procedure with visual demonstration of the walking test was given. Since we were not interested in the potential efforts of the cognitive task on changes in gait dynamics and gait instability and were not necessarily concerned with subjects performance on the cognitive task itself, we did not evaluate performance on the cognitive task.

Each subject completed one trial for all of the testing conditions. The walking trials were realized on a 10 meter walkway in a well lit environment at a self selected speed and wearing their own foot wear. The walkway 9 x 0.5 meter was marked on the floor with two sidelines and the subject was told not to step outside these lines while walking. The subject was followed by a spotter in case of falling. Each walking trial was recorded with a sony numeric video camera placed on a tripod in front of the walkway; number of steps, number of lateral stepping over and stops were counted and noted from the recording. Time required to complete the 9 meter course was recorded in seconds using a digital stop watch. Participants were given standard instruction to start walking after hearing "Start" and to keep walking until asked to stop. Both the acceleration and deceleration phase of gait were included for analysis. Average gait speed [velocity] was calculated and expressed in centimeter/seconds, the average cadence in number of steps/minute. The lateral stepping out and stops were counted and expressed in percentage.

Procedure

All tests of subjects were conducted in the physiotherapy O.P.D. of CSS Hospital, at Jai Physiotherapy and Dental Clinic, SF-06, Ansal Galleria, Ansal Town, Meerut, and Physiotherapy O.P.D. of S.B.S. Post Graduate Institute of Bio – Medical Sciences & Research, Balawala, Dehradun. Prior to testing, all the subjects were interviewed about their medical history and had explained the research procedure to them. This information was used to characterize the demographics and health status of subjects participating in the study. Cognition was evaluated by the score of Mini Mental Scale and the balance by the Berg's Balance Scale was completed.

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Data Analysis

All analysis were obtained using SPSS windows. Demographic data of subjects including sex, age, Berg's Balance Scale and Mini Mental Scale were descriptively summarized. The dependent variables for statistical analysis were gait cadence, gait velocity, lateral stepping out and stops. One way Multivariate analysis of Variance with repeated measures was performed, to analyze the differences in the gait performances among the three conditions: walking with no task, walking with motor task and walking with cognitive task readings. An á level of 0.05 was used to determine statistical significance. Follow up analysis of variance were conducted if the test demonstrated statistical significance.

All possible pair wise post hoc analysis was conducted on the significant dependent variable in order to compare difference between conditions. To prevent an inflation of type one error or to maintain á at p=0.05 for this follow up test; a Bonferroni corrected post hoc test was used.

Table 1: Demographic data

	N	Minimum	Maximum	Mean	SD
Age	50	65.00	75.00	67.90	4.80
BBS	50	41.00	56.00	47.78	3.92
MMS	50	22.00	30.00	27.82	1.99

Table 2: Mean and SD

Variables		Mean	SD
Cadence	**NTCAD**	108.32	20.28
	MTCAD	103.44	18.65
	CTCAD	101.06	22.66
Velocity	**NTVEL**	83.92	30.42
	MTVEL	81.23	28.87
	CTVEL	77.19	29.98
LSO	**NTLSO**	3.33	5.45
	MTLSO	3.68	6.35
	CTLSO	5.47	6.02
Stops	**NTSTP**	0.07	0.50
	MTSTP	0.15	0.76
	CTSTP	1.03	2.81

Table 3: Comparision within variables (post hoc bonferroni test)

Variables	Mean ± SD		P-Value	
NTCAD VS MTCAD	108.32 ±20.28	103.44±18.65	0.004	SIG
NTCAD VS CTCAD	108.32 ±20.28	101.06±22.66	0.039	SIG
MTCAD VS. CTCAD	103.44±18.65	101.06±22.66	0.946	NS
NTVEL VS MTVEL	83.92±30.42	81.23±28.87	0.005	SIG
NTVEL VS CTVEL	83.92±30.42	77.19±29.98	0.166	NS
MTVEL VS. CTVEL	81.23±28.87	77.19±29.98	0.155	SIG
NTLSOVS MTLSO	3.33 ±5.45	3.68±6.35	0.998	NS
NTLSO VS CTLSO	3.33 ±5.45	5.47±6.02	0.034	SIG
MTLSO VS. CTLSO	3.68±6.35	5.47±6.02	0.083	NS
NTSTP VS MTSTP	0.07±0.50	0.15±0.76	0.987	NS
NTSTP VS CTSTP	0.07±0.50	1.03±2.81	0.070	NS
MTSTP VS. CTSTP	0.15±0.76	1.03±2.81	0.110	NS

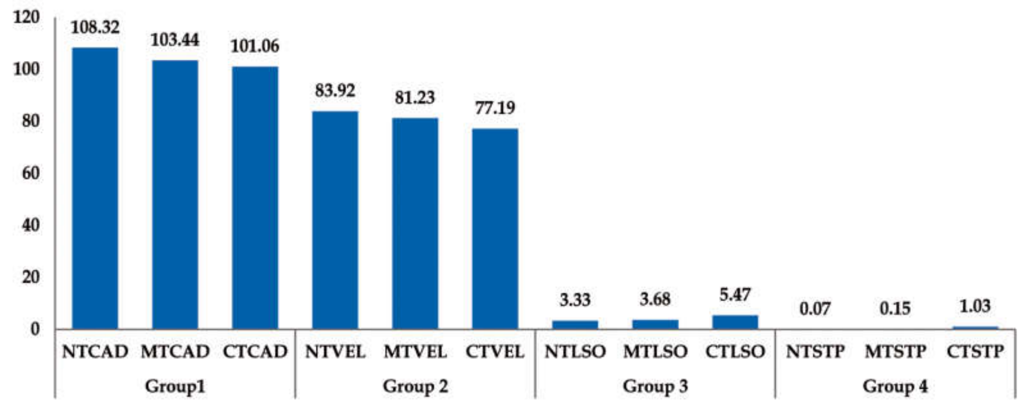

Fig. 1: Mean

Table 4: Anova

	No task	Motor task	Cognitive task	F	P
Cadence	108.3±20.3	103.4±18.6	101.1±22.7	5.317	.006
Velocity	83.9±30.4	81.2 ±30.4	77.2±29.9	6.844	.002
LSO	3.3±5.4	3.7 ± 6.4	5.5±6.02	4.158	.018
Stops	0.07±0.5	0.2 ± 0.8	1.03±2.8	4.824	.010

Significant at $p \leq 0.05$

Results

Base line characteristic of all subjects were summarized in Table 1. The mean score for age was 67.90 ± 4.80. The mean score for Berg's Balance Scale was 47.78 ± 3.92 and for Mini Mental Scale was 27.82 ± 1.99.

Effects of Secondary Task On Gait Performance

Assessment of gait performance in this experiment included four dependent variables: cadence, velocity, lateral stepping out and stops. One way Multivariate Analysis of Variance demonstrated a significant difference in gait performance among the three conditions (walking alone with no task, walking with motor task, walking with a cognitive task). Further analysis was performed to determine which dependent variable was significantly different among the conditions by using a follow up unvariate analysis of variance. Among the three conditions, there was a significant difference for the gait cadence (F=5.317, p=0.006), gait velocity (F=6.844, p=0.002), lateral stepping out (F=4.158,p=0.018) and stops (F=4.824,p=0.010). All possible pair wise post hoc comparisons were performed on gait velocity, gait cadence, lateral stepping out and stops, to compare conditions. Results are presented in the following sections (Table 4).

Effects of Secondary Task on Gait Velocity

Table 2, 3 and 4 illustrate that the geriatric subjects demonstrated a reduction in walking speed for the cognitive performance. Post hoc comparisons showed that significant difference for gait velocity between no task and cognitive task condition (p=0.005) and no significant difference in walking speed was found between the no task and motor task and also between cognitive task and motor task situations.

Effect of Secondary Task in Gait Cadence

Table 3, 4 and Figure 1 shows that the cadence values for each of walking conditions. The decline in mean cadence was seen with motor and cognitive task. In addition the post hoc comparison, there was significant difference between the no task and motor task situation (p=0.004) and also between the no task and cognitive task conditions (p=0.039), but no significant difference was seen between the motor and cognitive task condition. The mean cadence decreased with cognitive task compared to walking alone with no task and with motor task.

Effects of Secondary Task on Lateral stepping Out

Table 3, 4 and Figure 1 showed that the lateral stepping out values for each of the walking conditions. The mean lateral stepping out during cognitive task was more. The post hoc comparison showed significant difference among the no task and cognitive task condition (p=0.034), but no significant difference between the no task and motor task and also among the motor task and cognitive task conditions.

Effects of Secondary Rask on Stops in Gait

Table 3, 4 and Figure. 1 showed that the values for stops in gait in each of the walking condition. In contrast to the other dependable variable the secondary tasks did not have a significant effect on stops during gait.

Discussion

This study of 50 geriatric subjects, showed statistically significant changes in cadence, velocity, lateral stepping out and stops with simultaneous performance of secondary cognitive and motor task. The results showed that geriatric subjects experienced marked deterioration in their gait pattern when they are required to perform either a motor or cognitive secondary task at the same time as walking. The geriatric population had slower gait and reduction in speed when they engaged in dual task conditions. They reduced their cadence rate when required to perform another task while walking. The results show that the dual cognitive strategy had a greater effect on gait in geriatric population than did the dual motor strategy, suggesting that a cognitive task may be more difficult than a dual motor task.

Contrary to the prediction, the secondary motor task did not produce a statistically significant reduction in gait speed or an increase in the lateral stepping out and stops in the geriatric subjects, probably because the secondary task were relatively easy, highly familiar, well learned and performed routinely many times every week by geriatric population. The stepping rate of the elderly while performing secondary motor task was significantly decreased compared to base line. O'Shea.et.al. found that both cognitive and motor concurrent task reduced the performance of gait in Parkinson's disease subjects, however the type of secondary task was not a major determinant of the severity of dual task interference [2]. The natural walking velocity of the geriatric subjects was significantly reduced; this reduction was not due to a decrease in cadence, but rather to a reduction in stride length [12].

The stops during gait did not statistically differ in three of the different conditions; however frequency of stops was more in cognitive secondary task as compared to the baseline, clinically. The cognitive secondary task produced a statistically significant reduction in gait speed, the stepping rate, cadence or an increase in lateral stepping out, but did not produce a statistically significant increase in stops. The motor and cognitive secondary task did not show any statistical significant difference.

Conclusion

The results of the study show that elderly subjects attend to do a complex secondary task at the same time as walking, there is a significant dual task interference that compromises the cadence, speed of walking, lateral stepping out and stops. Cognitively demanding activity during walking appears to increase the gait interference more and therefore the type of secondary task was a major determinant of the severity of dual task interference. Performance changes in gait and secondary task when performed simultaneously, confirms that walking is an attention demanding task in elderly population.

The results of my study supports the hypothesis, within the limitation of this study. The result of this study provides a base for further research as they presents valuable outcomes for practitioners treating the geriatric population for cognitively demanding activity during gait training.

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A Quantitative Analysis of Prevalence and Characteristics for Reporting High-Quality Evidence in Physical Therapy Journals- A Systematic Review

Senthil P. Kumar*, Nisha Rani Jamwal**

Abstract

Context: Physiotherapy/ physical therapy practice, education, research and administration depend upon an evidence-based shared interpersonal decision-making process which in turn is based upon individual professional expertise and existing research evidence. The growing quantity and quality of research in evidence-informed physical therapy dictated and essentitated a leading role by professional scholarly journals. *Aims:* This study aimed to perform a quantitative analysis of systematic reviews/ meta-analyses and randomized controlled trials in physiotherapy journals indexed in MEDLINE/ PubMed. *Settings and Design:* Systematic review of physical therapy journals. *Methods and Material:* Twelve English-language physical therapy journals[Physical Therapy (PTJ)/ Journal of American Physical Therapy Association (JAPTA), Physiotherapy (PT), Journal of Physiotherapy (JoP)/ Australian Journal of Physiotherapy (AJP), Journal of Physical Therapy Science (JPTS), Physical Therapy Reviews (PTR), Physiotherapy Theory and Practice (PTP), Physiotherapy Research International (PRI), Physiotherapy Canada (PC), Brazilian Journal of Physical Therapy (BJPT), Journal of Japanese Physical Therapy Association (JJPTA), and Progress in Physical Therapy (PPT)] were identified using advanced search,and they were searched for articles with filtersactivated for article types- systematic reviews, meta-analysis, and randomized controlled trials, on 27th March 2016. The overall and study-specific and journal-specific reporting rates were computed descriptively using frequencies and percentiles in SPSS for Windows version 11.5. *Results:* The overall reporting rate among all journals was 4.38% for RCTs and 3.51% for SR/MAs respectively.PRI had the highest reporting rate for RCTs at 9.61% (57/593) followed by JoP/AJP at 7.79% (134/1720), and PTP at 7.69% (46/598). PRI also had the highest reporting rate for SR/MAs at 7.25% (43/593), followed by PTP at 7.02% (42/598) and BJPT at 5.74% (17/296). *Conclusions:* The overall reporting rate for high quality evidence in physical therapy journals was very low and there were only few randomized clinical trials and systematic reviews found. The study findings indicate a lack of adequate high quality evidence base in physical therapy literature published by physical therapy journals indexed in PubMed.

Keywords: Evidence-Based Physical Therapy; Research Evidence; Journal Reporting; Ppublication Trend.

Introduction

Physiotherapy/ Physical Therapy in its professional evolution in practice, education, research and administration is now inherently dependent upon an evidence-based shared interpersonal decision-making process which in turn is based upon individual professional expertise and existing research evidence [1]. This evidence-informed physical therapy further necessitates quality appraisal and evaluation of level of evidence of published articles prior to extrapolating their conclusions into a typical situation [2].

Systematic reviews (SR) and meta-analyses (MA) are regarded as the highest level of evidence (1a) in the evidence pyramid during literature search and

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quality appraisal for developing clinical practice guidelines and consensus recommendations [3]. SR are qualitative summaries of published literature selected for their homogeneity on patient characteristics, interventions/procedures, comparisons and outcomes based upon a specific research question which is diagnostic, therapeutic or prognostic [4]. MA are quantitative summaries of the same, and they provide statistical estimates not only of direction but also of magnitude in terms of 'effect size'. Some MA measures were standardized mean difference, relative risk, and odd's ratio, and MA always present forest and funnel plots in their graphical presentation of results [5].

Randomized controlled trials/ randomized clinical trials (RCTs) are ranked next in the evidence pyramid, and are the highest quality of evidence among primary research [6]. RCTs are experimental studies that either involve subject selection by random sampling or treatment selection by random assignment of treatment allocation [7]. The 'random'ness in methodology aims to reduce extrinsic and intrinsic bias thus enhancing external and internal validity of study findings in terms of contribution to evidence [8]. A controlled trial is one where the control group receives no treatment at all, whereas a clinical trial involves control group receiving standard care or conventional treatment [9]. Other comparators involve sham intervention such as a detuned intervention equipment or placebo such as an inactive intervention with induced positive therapeutic expectation in the subject [10].

The growing quantity and quality of research in evidence-informed physical therapy dictated and essentitated a leading role by professional scholarly journals. Thus this study was aimed to perform a quantitative analysis of systematic reviews/meta-analyses and randomized controlled trials in physiotherapy journals indexed in MEDLINE/ PubMed.

Materials and Methods

Systematic review of twelve English-language physical therapy journals [Physical Therapy (PTJ)/ Journal of American Physical Therapy Association (JAPTA), Physiotherapy (PT), Journal of Physiotherapy (JoP)/ Australian Journal of Physiotherapy (AJP), Journal of Physical Therapy Science (JPTS), Physical Therapy Reviews (PTR), Physiotherapy Theory and Practice (PTP), Physiotherapy Research International (PRI), Physiotherapy Canada (PC), Brazilian Journal of Physical Therapy (BJPT), Journal of Japanese Physical Therapy Association (JJPTA), and Progress in Physical Therapy (PPT)] were identified using advanced search, and they were searched for articles with filters activated for article types-systematic reviews, meta-analysis, and randomized controlled trials, on 27th March 2016. The overall and study-specific and journal-specific reporting rates were computed descriptively using frequencies and percentiles in SPSS for Windows version 11.5.

Results

Main Findings

PRI had the highest reporting rate for RCTs at 9.61% (57/593) followed by JoP/AJP at 7.79% (134/ 1720), and PTP at 7.69% (46/598). PRI also had the highest reporting rate for SR/MAs at 7.25% (43/593), followed by PTP at 7.02% (42/598) and BJPT at 5.74% (17/296). Two journals-PTR and PPT did not have any SR/MA or RCT. The results are shown in table-1 for journal-wise data. The relative contribution of PT journals and their comparisons are depicted in Figures 1,2 and 3.

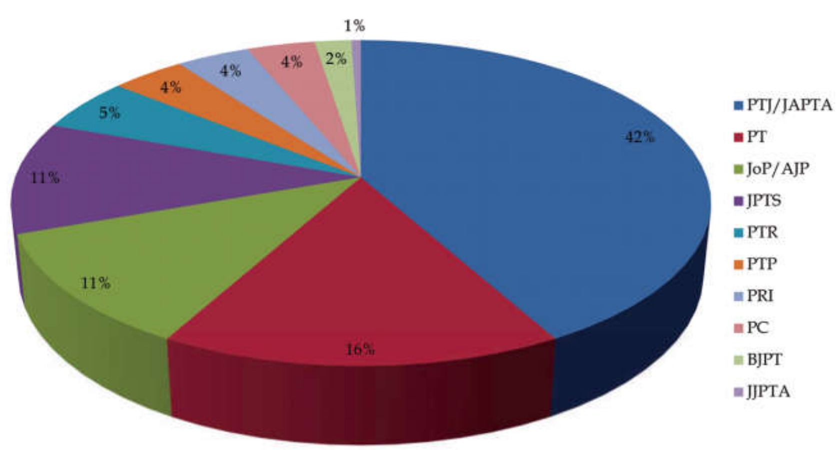

Fig. 1: Relative contribution by physical therapy journals for evidence in pubmed

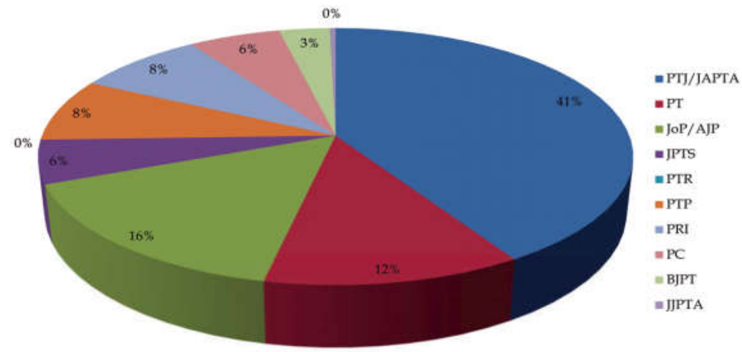

Fig. 2: Relative contribution by physical therapy journals for systematic reviews/ meta-analyses

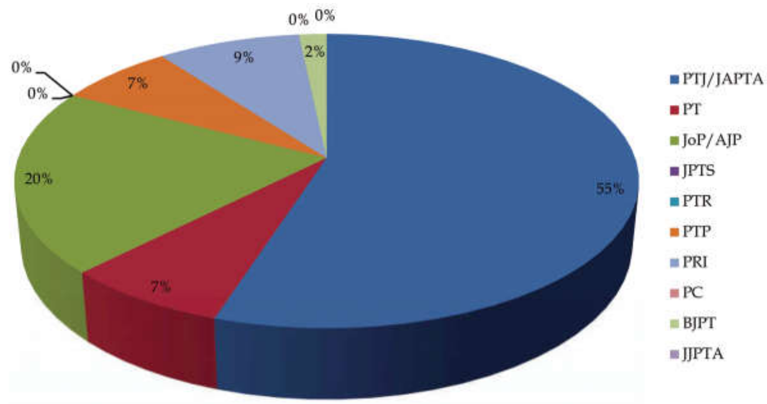

Fig. 3: Relative contribution by physical therapy journals for randomized controlled trials

Table 1: Comparison of reporting rates of systematic reviews/meta-analyses and randomized controlled trials among physical therapy journals indexed in PubMed

Name of journal	Total citations in PubMed N	Systematic reviews/ Meta-analyses (SR/MA) N1	Reporting rate for SR/MA N1/N %	Randomized controlled trials (RCT) N2	Reporting rate for RCT N2/N %
Physical Therapy (PTJ)/ Journal of American Physical Therapy Association (JAPTA)	6297	218	3.46	363	5.76
Physiotherapy (PT)	2414	64	2.65	49	2.02
Journal of Physiotherapy (JoP)/ Australian Journal of Physiotherapy (AJP)	1720	83	4.82	134	7.79
Journal of Physical Therapy Science (JPTS)	1666	29	1.74	0	0
Physical Therapy Reviews (PTR)	799	0	0	0	0
Physiotherapy Theory and Practice (PTP)	598	42	7.02	46	7.69
Physiotherapy Research International (PRI)	593	43	7.25	57	9.61
Physiotherapy Canada (PC)	552	31	5.61	0	0
Brazilian Journal of Physical Therapy (BJPT)	296	17	5.74	11	3.71
Journal of Japanese Physical Therapy Association (JJPTA)	77	2	2.59	0	0
Progress in Physical Therapy (PPT)	46	0	0	0	0
Total	15,058	529	3.51	660	4.38

Discussion

This first-of-its-kind study aimed at identifying the scholarly role played by PubMed-indexed PT journals towards dissemination of high quality evidence, and the findings were partially accepting the null hypothesis that very less RCTs and SR/MAs are published by PT journals. The causes may be two-fold; that either such studies are published in other medical and/or rehabilitation journals in PubMed, or in journals indexed in databases other than PubMed, such as Scopus, Proquest etc.

The study findings are in agreement with universally lesser prevalence of SR/MA in biomedical field in general, and also, similar reviews by Kumar and colleagues foundless reporting rates for SR/MA [11] and for RCTs [12] respectively in PubMed-indexed palliative care journals. Those two previous reviews also performed content analysis which implicated evidence-informed practice. Such analyses are warranted in PT journals to inform disease-specific, population-specific and outcome-specific queries for evidence [13].

Effectiveness studies should emphasize measurements of benefits and harm equally since evidence needs to account for other associated confounders such as placebo and nocebo [14]. Other suggestion for future high quality studies to incorporate reporting guidelines such as PRISMA [15] for systematic reviews/ meta-analyses and CONSORT [16] for RCTs. PT Journals need to ensure that their editorial policies and authors' instructions meet the demand of providing high quality evidence in the best standards of reporting. Review by McCarthy et al [17] is the best example, and such reviews are needed for PT journals and their performance trend. Such reviews would establish the journals' role in their profession, as previously reported for palliative care [18] rehabilitation [19] and manual/ manipulative therapy [20].

One major assumption of this review relied upon the accuracy of PubMed search filter and verification of study design was not done manually as a second-level. There is a possibility that SR/MA was listed as simple review or RCT was listed as a Controlled clinical trial or clinical trial in PubMed, and vice versa. The search strategy utilized in this study was a non-validated and is prone to selection/ inclusion bias which would limit the applicability of this review. Other limitation of this review was inclusion of only English-language journals which reduced the opportunity for assessing high quality PT evidence in other languages.

Other incidental observations include; (1): Although PTJ is the top-ranked PT journal indexed in PubMed for many years, the reporting rate was less due to overall large number of articles published and its monthly publication periodicity; (2): PRI had highest reporting rate for both SR/MA and RCT which indicated its emerging leadership role as a high quality evidence provider among PT journals; (3): Many journals (PT, JPTS and PC) published more SR/MA than RCT which might be attributed to editorial policies of trial registration and ethical issues associated with RCT [21] thus making SR/MA easily publishable than a RCT; (4): PTJ holds the most number of high quality evidence compared to other journals understandably due to its well-developed editorial and publishing policies, and hence its contribution to evidence base for PT in PubMed is worth mentioning.

PubMed was chosen since it was regarded as a holy grail of evidence [22] or as an altar of science [23] in literature search, and hence the study findings might be extrapolated to reflect the current status of evidence per se. However the current status of practice also needs to be reported as practice-based evidence [24] and both goes hand-in-hand towards scientific development of the profession.

Disclosure

SPK is chief editor for *Journal of Physical Therapy (JPT)* and associate editor for *Physiotherapy and Occupational Therapy Journal (POTJ)*, both of which were not included in this review since they are not indexed in PubMed.

Conclusion

The overall reporting rate for high quality evidence in physical therapy journals was very low and there were only few randomized clinical trials and systematic reviews found. The study findings indicate a lack of adequate high quality evidence base in physical therapy literature published by physical therapy journals indexed in PubMed. However, similar reviews of journals indexed in other databases or other professional disciplines would be warranted to identify the source of high quality evidence in PT.

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Efficacy of High Intensity Laser Therapy (HILT): A Review of Literature

Jagmohan*, Saurabh Sharma**

Abstract

Laser therapy irradiation have shown a positive response to the damaged and impaired oxygenation because of trauma, inflammation and swelling. Although there are numerous evidences for the low laser therapy in view of this but coming into existence is the High intensity laser therapy(HILT) which at present has got only a limited number of evidences in case of soft tissues injuries. It has been reported that the use of HILT provides a significant reduction in pain levels in acute and chronic conditions such as Osteoarthritis, Rheumtoid arthritis, Carpal tunnel syndrome,Fibromyalgia, Subacromial impingement syndrome(SAIS)etc [1-3]. The aim of the review article is to review the available researches done on the soft tissue injury management by High intensity laser therapy and to be able to bring about a common conclusion.

Keywords: High Intensity Laser Therapy(HILT); Low Level Laser Therapy(LLLT); Subacromial Impingement Syndrome(SAIS); Post Mastectomy Pain Syndrome(PMPS); Lateral Epicondylitis.

Introduction

The term LASER stands for " Light amplification by stimulated emission of radiations". Lasers for many decades have been used in a variety of medical applications such as LASIK, laser hair removal, surgeries etc. Low energy laser was pioneered in Europe and Russia [4]. Andre Mesterfirst observed the cellular changes in mice caused by a low level of laser energy in the year 1950(Mester 1967). Since then thousands of studies have been done to estimate the influence on cellular repair, reproduction or inhibition. (Hode and Turner 2002).

There are three basic principle of lasers, i.e. Collimation, Coherence and Monochromacity so it is the amplification of electron spin rates by passing photon energy through a particular medium to produce a single unidirectional laser beam having a different wavelength than the original beam [5]. Therapeutic lasers work on the mechanism of photo-biostimulation i.e. stimulation occurs at multiple levels of the cell, vascular structures, immune system and interstitial tissues.Photochemical effects occurs when laser light is absorbed by a chromophore. The most supported mechanism is that cytochrome C absorbs light from 500nm to 1100nm due to the specific properties of this large molecule (Karu 1995). Karu suggested that once the light is absorbed Cytochrome C is excited which entrails a cascade of reactions which causes short term activation of the respiratory chain (eg. Cytochromes, cytochrome oxidase and flavine dehydrogenase), leading to changes in redox status of both mitochondria and cytoplasm

Low level laser therapy (LLLT) has been under investigation and clinical application for more than 30 years, among which many studies favors the safety and efficacy of LLLT. Around the year 2000, lasers were widely used in the physical therapy and occupational therapy which are low level having a power output between 5mW TO 500mW. These devices have called "Low level laser" or "cold laser ". Cold laser term was coined because almost therapeutic lasers when used clinically will produce a small temperature changes in tissue if used for any significant time. The important thing to focus is that rise in the tissue temperature is not by the cause of cellular changes but it is caused by photochemical response to the absorbed laser light.

The expansion of laser therapy for pain

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management, inflammatory reduction and accelerated healing has driven the need for higher power output levels and longer wavelengths resulting in penetration of deeper tissues, since past 1 decade, there has been increasing trend to increase the power density and dose of lasers which brought high intensity laser therapy(HILT) into existence. Earlies therapeutic lasers offered a power output of only 5mW but current FDA cleared lasers can provide up to 10,000mW of power output. The best clinical results are achieved when an optimal number of photons reach the target tissue. The therapeutic dose of lasers is measured in Joules(J) delivered per cm^2. The World Association of Laser Therapy has established that the target tissues require a dose of 5-7 J/cm^2 to bring about a biological cellular response.

More recently, a form of high intensity laser therapy was introduced in physical therapy i.e. Pulsed Neodynium-doped yttrium aluminum (Nd:YAG) laser as compared to traditional lasers such as Helium Neon (He-Ne) and Gallium Aluminum Arsenide lasers(GaAlAs) which are almost outdated now. Nd:YAG works with a peak power of about 3kW and wavelength of 1064nm and considered to be a non-painful and non-invasive therapeutic electrotherapy modality. Higher intensity laser radiation causes minor and slow absorption of light by chromophores which is not obtained with concentrated light but with diffuse light in all directions (scattering phenomenon) resulting in increased mitochondrial reactions and ATP, RNA or DNA production (photochemistryeffects) and causing tissue stimulation (photobiologyeffects) HLLT has got an advantage over LLLT that it is able to penetrated deeper and so stimulates large and deep tissues [6]. Earlier studies have well documented the anti-inflammatoryand analgesic and anti-edematous effects of Nd:YAG lasers, justifying the evidence to incorporate in patient with pain issues. Here I review the available papers about the effectiveness of high intensity laser therapy in soft tissues. An online research from PubMed, science direct, laser medical science using the key words High intensity laser therapy(HILT) was performed.

Review of Articles

In a randomized control trial, Andrea et al [7] (2009) studied the short term effectiveness of HILT vs ultrasound therapy in 70 patients with subacromial impingement syndrome over 2 weeks, results showed greater pain reduction and improved articular movement and muscular strength of the affected shoulder after 10 treatment sessions with HILT as compared to US therapy group over a period of 2 consecutive weeks.

In an another study, Alayat et al [8] (2014) compared the effects of HILT alone or combined with exercise in the treatment of chronic low back pain in 72 male patients over 4 weeks and 12 weeks of follow up. Outcome measures such as Lumbar range of motion, VAS, Roland Disability Questionnaire (RDQ) and Modified Owestry Disability Questionnaire(MODQ). Results were HILT combined with exercise appeared more effective than either HILT alone or placebo laser with exercise.

Alayat et al [9] (2014) conducted a randomized control trial to compare the effects of low level laser therapy(LLLT) Vs high intensity laser therapy (HILT) on 53 knee osteoarthritis patients. Results revealed that HILT and LLLT combined with exercise program were efficient indecreasing the VAS and WOMAC scores after 6 weeks of treatment. However, HILT with exercises was much more efficient than LLLT withexercises and both modalities were better than exercises alone in the treatment ofpatients with knee OA.

In an another randomized doubleblind placebo control trial by Alayat et al [10] (2016) investigation of the effects of HILT in 60 chronic neck pain patients taking into account outcome measures such as cervical ROM,VAS and Neck Disability Index(NDI). After 6 weeks of treatment, cervical ROM, VAS and NDI scores improved significantly in all the groups but HILT with exercise showed much better results during in group comparison.

Another randomized study by Haladaj et al [11] (2015) assessed the progress of rehabilitation in 150 patients with cervical radicular pain syndrome after using two different methods of treatment: HILT(Group 1) and Spinal traction withSaunders device(Group 2). Results showed greater analgesic efficacy, improved global mobility and reduced functional impairment in patients treated with Saunders method as compared to HILT group.

Dundar et al [12] (2015) did a prospective, randomized, controlled study to investigate the effects of HILT in patients with lateral epicondylitis and further comparing it with results of brace and placebo HILT. Results at 4 weeks and 12 weeks of treatment showed significant improvement for HILT and brace groups in pain scores, grip strength, disability scores and several subparts for short form 36 health survey.

Akkurt et al [13] (2016) investigated short and long term effects of HILT in 30 lateral epicondylitis patients on VAS, DASH and Hand Grip Strength test (HGST). Results showed activity and resting VAS, DASH and HGST scores significant improved following treatment at 6 months.

In another double blind, placebo control, randomized study by Ebid et al [14] (2015) to assess the long term effect of pulsed HILT in treatment of the post mastectomy pain syndrome(PMPS) in 61 patients for 4 weeks. Outcome measures were VAS, Shoulder ROM and Quality of life(QOL). Results showed significantly increased shoulder ROM in laser group after 4 weeks of treatment and after 12 weeks of follow up as compared to the placebo group and QOL showed a significant improvement in laser group which still improved after 12 weeks of follow up.

Discussion

However only few studies have been done on high intensity laser therapy(HILT) efficiency on soft tissues, regarding the results of most studies, it seems that HILT can be an appropriate alternate for the current treatment as compared to other electrotherapy modalities such as low level laser and ultrasound therapy which were among the mainstay of the treatment.

Andrea et al [7] showed that HILT is better than ultrasound therapy in short term effectiveness in 70 SAIS patients over 2 weeks of treatment. However, there is a need for long term effectiveness and contradictoryfact about the soft tissue healing in 2 weeks.

Alayat et al [8] showed that isolated HILT is not effective in treating chronic low back pain but that study has a lack of exercise therapy protocol in conjunction with HILT which signifies the limitation of HILT.

Another study by Alayat et al [9] compared the LLLT with HILT on 53 OA patients which showed that both the modalities are effective in relieving pain if used with exercises but effects of HILT with exercises were much more pronounced than LLLT with exercises.

Alayat et al [10] studied effectiveness of HILT on chronic neck pain of 60 patients over 6 weeks which again showed the HILT with exercises are beneficial.

Haladaj et al [11] showed thatSaunders device is more effective than HILT in chronic radicular pain syndrome which showed that HILT has not limitations without any other active intervention.

In lateral epicondylitis, HILT proved to be beneficial as compared to placebo and brace groups by Dundar et al [12] which shows the efficacy of HILT in tendinosis, however the chronicity of lateral epicondylitis was not mentioned in the study.

Another study by Akkurt et al [13] on short term and long term effects of HILT in lateral epicondylitis showed increased functionality but pre-treatment and post-treatment ultrasonographyevaluation could have added to the knowledge for the of tendon composition and changes as a result of laser irradiation.

HILT was found to be beneficial in post-mastectomy pain syndrome in a study Ebid et al [14].

There are different mechanism for the pain attenuation by the lasers which include increase in ATP production, prostaglandin(PG) synthesis, conversion of PG type G and PG type H_2 into PG type I_2 , increased pain threshold in nerve fibers, decreased histamine and serotonin secretion, increased local microcirculation, promoting angiogenesis, decrease bradykinin production , lymph node circulation and edema decline, increased serotonin secretion in urine, increase in beta-endorphins CSF levels, increased glucocorticoids urinary secretions, changes in activity of epinephrine and norepinephrine, modulates inflammatory pain by reducing the levels of biochemical markers (PGE2 ,mRNA Cox2 , IL-1β , TNF-α), oxidative stress and neutrophil cell influx [15-17].

Conclusion

HILT is an effective treatment for the soft tissue injuries when combined with a suitable exercise therapy protocol. HILT alone has got very limited number of evidences to support the effectiveness. Moreover, HILT focuses on the symptoms of the injury rather than targeting the actual cause for it, so further evidences are required to support the isolated effectiveness of HILT.

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Review Article

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Effects of Cranial Nerve Non-Invasive Neuromodulation (CN-NINM) Technology on Various Neurological Disorders

Anusha Sampath*, Savita Tamaria**

Abstact

This article discusses the benefits of Cranial-nerve non-invasive neuromodulation (CN-NINM), which is a multi-targeted rehabilitation therapy that initiates the recovery of multiple damaged or suppressed brain functions affected by neurological disorders. Various Previous works has shown the feasibility of using the tongue as a route to deliver non-invasive electrical signals to the brain though the cranial nerves with afferent glossal innervation. In addition, the anatomy of cranial nerve nuclei within the brainstem allows for possible interaction of the incoming neurostimulatory signal with other anatomical or functional pathways and the possibility of neuromodulation within these and higher centers of the central nervous system (termed Cranial Nerve Non-Invasive Neuromodulation or CN-NINM). CN-NINM appears promising for treatment of full spectrum of movement didorders, and for both attention and memory dysfunction associated with traumatic brain injury.

Keywords: Neurorehabilitation; Neuroplasticity; Neurostimulation; Cranial Nerve; Brainstem; Tongue.

Introduction

First of all, although conventional physical rehabilitation therapy does employ retraining with the intention to return the patient to normal function, this occurs primarily during the acute and postacute period after trauma (typically up to 1 year). CN-NINM technology is oriented primarily on reha-bilitation during chronic stages (years after traumatic inci-dent), when conventional thinking assumes that there is no further capacity for change. It is deployable as a simple, home-based device (portable tongue neurostimulator, PoNSTM) and targeted training regimen following initial patient training in an outpatient clinic. It may be easily combined with all exist-ing rehabilitation therapies, and may reduce or eliminate need for more aggressive invasive procedures or decrease the total medication intake. CN-NINM uses sequenced patterns of electrical stimulation on the tongue. CN-NINM induces neu-roplasticity by noninvasive stimulation of two major cranial nerves: trigeminal, CN-V, and facial, CN-VII. This stimula-tion excites a natural flow of neural impulses to the brainstem (pons varolli and medulla), and cerebellum, to effect changes in the function of these targeted brain structures.

Integrated CN-NINM therapy intends to restore physi-ological and cognitive functions affected by brain injury beyond traditionally expected limits, by employing both newly developed and novel therapeutic mechanisms for pro-gressive physical and cognitive training, while simultane-ously applying brain stimulation through a device we call the Portable NeuroModulation Stimulator. Based on our previous research and recent pilot data, we believe a rigorous in-clinic CN-NINM training program, followed by regular at-home exercises also performed with PoNS, simultaneously enhances, accelerates, and extends recovery from multiple impairments from brain injury (e.g., movement, vision, speech, memory, attention, mood), based on divergent, but deeply interconnected neuro-physiological mechanisms[1-4].

Conceptual Framework

Long term potentiation is the phenomena of synaptic structural remodeling and formation of new synaptic contacts that is acti-vated by high frequency stimulation [5-8]. After 10–40 minutes of high-frequency stimulation (50–400 Hz, range of

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frequencies used in animal research) the number of synapses and proportion of multiple spine boutons can increase the efficiency of neural connections. [9]. Effects of LTP can continue during several hours and even days [10,11]. Using the PoNS device, prolonged and repetitive activation (20 minutes or more) of functional neuronal circuits (balance, gait) can initiate long-lasting pro-cesses of neuronal reorganization (similar to LTP), that we can see and measure in subjects' behaviour. The functional improvement after initial training sessions continues for sev-eral hours. Multiple regular sequential train-ing sessions lead to consistent increase of improved symptom duration and cumulative enhancement of affected functions.

This regular excitation may also increase the receptiv-ity of numerous other neural circuitries and/ or affect inter-nal mechanisms of homeostatic self-regulation, according to contemporary concepts of synaptic plasticity. We cannot exclude also that this induces simultaneous activation of serotoninergic and noradrenalinergic regulation systems of the brain as well. The result of this intervention is essentially brain plastic-ity on demand—a priming or upregulating of targeted neural structures to develop new functional pathways, which is the goal of neurorehabilitation and a primary means of func-tional recovery from permanent physical damage caused by stroke or trauma.

Purposeful Neurostimulation

The PONS device was designed to provide optimized neurostimulation via the tongue specifically to induce neu-romodulation as part of CN-NINM therapy. In this sense it belongs to two broad categories of technologies. The first category includes devices that electrically activate the ner-vous system.

The elec-trode array of the PoNS device induces an electric field in the tongue epithelia that based on the relevant anatomy and sensory percept, activates sensory fibers (pre-dominantly mechano, thermo, and free nerve endings) to a depth of approximately 300–400 ìm. This creates a massive flow of action potentials that are perceived by the subject. as a "buzzing" or "champagne bubble" sensation. Here, the stimulation is a flow of neural impulses filling the brain-stem nuclei through the trigeminal and facial nerve fibers. Activation of primary targets—these brainstem nuclei neurons—happens through existing synaptic connections, initiating a cascade of activation through multiple neural circuitries.

Pons Device

The current-generation PoNS device achieves localized electrical stimulation of afferent nerve fibers on the dorsal surface of the tongue via small surface electrodes. Because of the resulting tactile sensation, which, depending on stimulation waveform, typically feels like vibration, tin-gle, or pressure, it is certain that tactile nerve fibers are acti-vated. Taste sensations are infrequently reported, although it is not known whether gustatory afferents are in fact stimu-lated, given the nonphysiological patterns of activation likely to result from PoNS-induced stimulation of these fibers.

Physical Construction

The PoNS device is held lightly in place by the lips and teeth around the neck of a tab that goes into the mouth and rests on the anterior, superior part of the tongue. The paddle-shaped tab of the system has a hexagonally patterned array of 143 gold-plated circular electrodes (1.50-mm diameter on 2.34-mm centers) that is created by a photolithographic process used to make printed circuit boards. The board is an indus-try-standard polyimide composite that is USP Class VI com-pliant and meets ISO 10993 biocompatibility standards. The edges and nonelectrode surface of the array tab are coated with a rugged USP Class VI biocompatible epoxy. Therefore, the only materials that contact oral tissues are the gold elec-trodes and the biocompatible polymers. The remainder of the PCB and all electronic components, including battery, are in a sealed Delrin (USP Class VI compliant) enclosure that remains outside the mouth. Although the PoNS device is built using biocompatible materials, it is investigational and not approved by any regulatory agency. Device function is user-controlled by four buttons: On, Off, Intensity "Up," and Intensity "Down." The PoNS device is powered by an inter-nal battery that may be recharged via an external power sup-ply that plugs into a 120-V or 240-V AC electric mains outlet, similarly to a mobile phone.

Electrical Stimulation

The tongue electrodes deliver 19-V positive voltage-con-trolled pulses that are capacitively coupled both to limit maximal charge delivered under any rare circuit failure and also to ensure zero DC to the electrodes, minimizing poten-tial tissue irritation from electrochemical reactions. Tongue sen-sitivity to positive pulses is greater than that for negative pulses. The pulse width is adjustable in 64 unequal steps from 0.3 to 60 ìs by the intensity buttons. This intensity control scheme takes advantage of the steep section of the strength–duration relationship for electrical stimulation of neural tissue [12].

These pulses repeat at a rate of 200 per second, within the typical physiological firing rate for tactile afferents. Because of the neural refractory period, and extrapolated from earlier single-fiber median nerve response to similar electrotactile stimuli on a rhesus mon-key fingerpad (Kaczmarek et al., 2000), it is presumed that at most one action potential results in any given afferent fiber for each stimulation pulse. To minimize sensory adaptation [13] and to ensure a good quality of sensation[14] , every fourth pulse is removed from the pulse train, so that each electrode deliv-ers a burst of three pulses every 20 ms . This combination of pulse amplitude and width results in an elec-trotactile stimulus that may be varied by the user from well below sensory threshold to a perceived sensation at the upper limit of comfortability.

Electrode Array and Pulse Sequencing

The PoNS electrode array, irregularly shaped to take advan-tage of the most sensitive regions of the tongue, comprises 143 electrodes nominally organized into nine 16-electrode sec-tors. Within each sector, one electrode is active at any moment (pulse beginnings staggered by 312.5 ìs), with unstimulated electrodes serving as the return current path. The nine sectors present simultaneous stimulation, with the intensity of each sector adjusted to compensate for the variability of tongue sensitivity to electrotactile stimuli[15].

The sensation produced by the array has been described as similar to the feeling of drinking a carbonated beverage. The electrode size and geometry were chosen to achieve a reasonable balance between number of electrodes that may be packed into the array area and the comfortability and control-lability of the electrotactile percept [16]. The overall result of this stimulation is the comfortable and convenient presentation of almost 26 million stimulation pulses to the tongue during a typical 20-minute therapy ses-sion. How many action potentials are propagated to the brain as a result of this surface stimulation is at this point unknown.

CN-NINM Training with the Pons Device

The goal of CN-NINM training is to recover normal movement control. By combining brain activation with tar-geted physical training, we believe we are affecting neural pathways directly related to the task. Through experimenta-tion in multiple studies with various populations (TBI, stroke, multiple sclerosis, Parkinson disease), we have found that the most effective way to train using this technology involves five main components:

1. Movement training
2. Balance training
3. Gait training
4. Cognitive training
5. Breathing and awareness training (BAT)

Individuals are trained in the clinic initially for 1 to 2 weeks (Monday through Friday). As they improve, they are challenged with harder tasks in order to progress. After the clinical training period, they continue training at home, performing the same components of CN-NINM train-ing that they learned in the clinic. Individuals return to the clinic approximately at weekly and monthly intervals to review training

Daily Training Session Sample

Morning	Movement training—warm-up exercises
Balance training with PoNS	20 minutes
Gait training with PoNS	20 minutes
Cognitive training with PoNS	20 minutes
Break	3–4 hours
Afternoon	
Movement control exercises with PoNS	20 minutes
Balance training with PoNS	20 minutes
Gait training with PoNS	20 minutes
Cognitive training with PoNS	20 minutes
Evening	
BA Twith PoNS	20 minutes

Various Studies

Gait

Four Subject TBI Cohort Dynamic Gait Index Results

The results presented below represent the changes over a 5-day period of CN-NINM intervention in subjects with a TBI. Four female subjects (mean age:

48.3) presented with sustained and significant balance and gait deficits from mod-erate closed-head, nonpenetrating, concussive TBI (9–13 on Glasgow Coma Scale) at initial diagnosis. All were approxi-mately 5 years postinjury and had previously completed rehabilitative therapy programs at their respective primary care facilities. The Dynamic gait index scores indicate significant improve-ments in stability and gait that are retained for as much as 6 hours after completion of the second intervention session of the day.

Single TBI Subject Electromyelogram Results

Additional quantitative gait analysis using electromyography was performed on one of these subjects . At baseline, it revealed desynchronization of muscular activity—early acti-vation of the left soleus during stance, and delayed activation of the left vastus lateralis, creating an abnormal gait pattern. After 1 week of CN-NINM rehabilitation, much more normal phasing of both these mus-cles is present when the subject walked at the same speed. The medial hamstrings and medial gastrocnemius were not substantially affected, exhibiting similar phasing both before and after treatment.

Stroke Subject DGI Results

Careful analysis of gait improvement in a stroke subject revealed a very important feature of CN-NINM training. The training protocol included balance, gait, and movement train-ing (see previous section) during the initial 2 weeks in the laboratory, and an additional 5-day retraining and adjustment every month. In between the laboratory training sessions, the subject was instructed to continue the training at home. In this particular case, measurements of gait performance were conducted before and after every in-laboratory training period. Results are presented in Figure 44.7, which shows that the subject's gait performance improved 48% over 6 months. However, development of such performance was not smooth and continuous, but looks stepwise.

Balance

1. The four TBI subjects were tested on the NeuroCom CDP Sensory Organization Test (SOT) before and after the week of twice-daily interventions. A composite score is calculated and compared with a database normalized for age and height. It was found that greatest functional improvement occurred in the most dynamic and challenging tasks
2. A study was done in 6 patients with various balance dysfunction etiologies who underwent one week of therapy with CN-NINM. All patients had an MRI scan on the day before the start of the therapy week and another MRI scan within three hours after completing the last therapy session. Five age and gender-matched healthy controls also underwent an MRI scan but did not receive any CN-NINM therapy. It has been concluded that CN-NINM modulates neural activity in the dorsal pons, and this modulation remains even when stimulation has been removed [17].

Cognitive Function

1. Additionally, TBI subjects C and D were tested for changes in cognitive function, memory, attention, and mood both before the 5-day intervention began, and within 24 hours of com-pleting the training. Their primary indications and scores on the Brief Repeatable Battery of Neuropsychological Tests showed improvement.

Eye Movement

1. Beginning with our first studies with rehabilitation of periph-eral and central balance disorders, we noticed striking effects of CN-NINM training on the recovery of visual dysfunctions (oscillopsia, abnormal nystagmus, color perception, visual acuity, light and dark adaptation, limits of visual field). Similar and even stronger effects were observed during studies with stroke, traumatic brain injury, multiple sclero-sis, and Parkinson subjects.

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Corrigendum

Corrigendum to, "Systematic Reviews on Spinal Manipulation: What does the Best Evidence about the Best Intervention Gives us?"

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The original published version of this Article contained errors in the list of the authors mentioned, Senthil P. Kumar, Asir John Samuel. The last author, Asir John Samuel, who is not a part of this research, has to be removed.

Now read as,

Senthil P. Kumar. Systematic Reviews on Spinal Manipulation: What does the Best Evidence about the Best Intervention Gives us? Physiotherapy and Occupational Therapy Journal 2016;9(1):5-8.

Error is regretted.

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Corrigendum

Corrigendum to, "Physiotherapy/Physical Therapy Journals: Earthing or Unearthing of Scientific Evidence."

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The original published version of this Article contained errors in the list of the authors mentioned, Nisha Rani Jamwal, Senthil P. Kumar, Asir John Samuel. The last author, Asir John Samuel, who is not a part of this research, has to be removed.

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Improvement in Physical Performance Parameters with Whole Body Vibration

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Abstract

As a training method of performance enhancement in sports, whole body vibration has recently been of increasing interest. However, the mechanisms responsible for the effects of whole body vibration are not sufficiently studied. Whole body vibration includes stimulating the nervous system and the muscles through direct or indirect devices. This paper consist of the review of the articles available in literature published in various journals like biology of sports, journal of strength and conditioning research, European journal of Appl physiol, journal of medicine and journal of physical fitness and performance from 2002 to 2016 about the effect of whole body vibration on the vertical jump height, balance and strength of lower extremities. Whole body vibration has been found to be an effective treatment modality in improving jump height as well as balance.

Keywords: Whole Body Vibration; Counter Movement Jump; Squat Jump; Isokinetic Dynamometer; Shuttle Run.

Introduction

The technology of whole body vibration was developed in the 2nd half of the 20th century. It was developed as a way to lessen loss of bone density and muscular mass in astronauts exposed to condition of zero gravity [6-10]. Whole body vibration is also known as indirect vibration.

This is achieved by using a commercially manufactured machine having an oscillatory platform moving in the vertical plane or in the side alternating motion about a central axis. Vertical sinusoidal oscillations are periodically produced by the platform transferring energy to human body.

These oscillations cause rapid eccentric – concentric contractions in the muscles causing muscular performance enhancement mediated by a rapid reflex and stretch reflexes (Ritzman et al 2010). These involve the tonic vibration reflex (Pollock et al 2012). The mechanism involves the stimulating effect of the rapid muscle stretching on the neuromuscular spindles which in turn boost up the myelinatedIafibres (Eklund and Hagbarth, 1973). The thick myelinated Ia fibres then send impulses to the alpha motor neurons in the anterior horn of spinal cord. Other mechanism for the response of whole body vibration may include angiogenic factors (outgrowth of new capillaries from vessels) like Vascular Endothelial Growth Factor [11-14], testosterone, growth hormone [15] and activation of stem cells [16].

As found in the literature, some of the beneficial effects of the whole body vibration are increase in strength and power, bone density improvement, hormonal secretion changes falls prevention etc (Bosco et al., 1999; 2000; Cardinale and Rittweger, 2006;). Various parameters of whole body vibration are vibration frequency and acceleration, exposure time and duration of training, total loading, exercise type and work loading [17, 18].

Jumping is the most important attribute of performance in volleyball players. It has been found that player performing better has high vertical jump values [19]. Whole body vibration has been found to improve vertical jump performance. Also, it has been found that low amplitude, high frequency whole body vibration improves muscle strength and balance of an individual [20-30] .

Various studies evaluating whole body vibration training across various sporting activities and level

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of sports reports the efficacy of WBV in improving performance. Enhancement in performance of explosive activities like vertical jumping are much more reported.

Review of Articles

In one study conducted by Perez – Turpin J.A et. al. in 2014, 23 subellite male volleyball and 11 beach volleyball players were divided in to 2 groups. One of the group received training with whole body vibration for 6 weeks while the other group underwent traditional strength training programme. Measures used to evaluate the performance were the squat jump and countermovement squat jump measured by Ergotester contact platform and maximum leg press(1 RM). Results showed that whole body vibration training leads to much better improvement in jump performance and strength in the players than the traditional strength training.

In another study conducted by Cochrane et. al in 2004, 24 sport science students (16 men and 8 women) were divided in to 2 groups. One group received whole body vibration training for 9 days while the other group was the control group. Contermovement jump height, squat jump height, sprint speed over 5, 10 and 20 m and agility (505, up and back) were reported before and after training. Result showed no significant difference between training group and the control group for counter movement jump, squat jump, sprint and agility.

C J de Ruiter et al conducted a study in 2003 in which 20 subjects were divided equally in to an experimental and a control group, in experimental group, training was given 3 times a week, they were made to stand barefoot with a 110 knee flexion angle on vibration platform for a total of 11 weeks of training. control group followed the same procedure but did not stand on the vibration platform. Countermovement jump height and functional knee extensor muscle strength were measured pre and post training. Result showed that counter movement jump height was unaffected by the whole body vibration. Also, the muscle strength did not improve.

In a study conducted by Shiuan- Yu Tseng in 2015, 45 elderly subjects were divided in to 3 groups. One group underwent whole body vibration training with eyes open, 2nd group received visual feedback deprived whole body vibration training and the 3rd group was the control group. The training was given for 3 months , 3 times a week for 5 minutes on each session. Limits of stability test was used for balance assessment and the isokinetic dynamometer was used for muscle strength assessment. Results showed that visual feedback deficient group had the greatest improvement in both the balance and the strength than the other 2 groups.

Torvinen SP, Kannus et al conducted a study in 2002 in which 56 voluntanteers were randomly divided in to 2 groups- one is whole body vibration group undergoing intervention for 4 months and the other one was the control group. Vertical jump, isometric extension strength of lower extremity, grip strength, shuttle run and postural sway were measured. Results showed that jumping power was improved in the whole body vibration group than the control group. However, no effect of whole body vibration was found on the static and dynamic balance.

Discussion

However, few studies have been done on the effect of whole body vibration on performance, the results of some of the studies reveal positive effect of WBV on vertical jump height, balance and strength while some studies on the other hand proves no effect of whole body vibration on these parameters.

Perez Tupin JA et al proved the efficacy of whole body vibration in improving vertical jump performance and strength in volleyball players when compared to the traditional strength training.

Another study conducted by Torvinen SP kannus et al supported the findings of Perez Tupin JA. He concluded that jumping power and height was improved by whole body vibration.

However a study conducted by Cochraine et al showed no effect of whole body vibration on counter movement jump height and squat jump. Similarly, CJ de Ruiter concluded in his study that countermovement jump height as well as the lower extremity muscle strength was not improved with whole body vibration.

As some studies proved efficacy while the others rejected its effectiveness in jump height, further study is required in this direction.

Shiuan – Yu Tseng proved that whole body vibration along with the removal of visual feedback is s very effective tool in improving balance and strength.

However, another study by Torvinen SP Kannus revealed no beneficial effect of whole body vibration on static and dynamic balance.

Whole body vibration works by transferring energy to human body through an oscillatory platform which facilitates the tonic vibration reflex through monosynaptic and polysynaptic pathways and the stimulation of the reflex involuntary muscle contractions.

A further research on the efficacy of whole body vibration on jump height and balance is needed as there are few studies supporting its effectiveness and some rejecting it. Studies should also be conducted comparing the effects of different parameters of whole body vibration on vertical jump height and performance.

Conclusion

Whole body vibration can be used as a training modality in improving vertical jump performance, balance and strength of lower extremity but further study is recommended. Whole body vibration without visual feedback was found superior to the only whole body vibration in improving balance.

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Standard journal article

[1] Flink H, Tegelberg Å, Thörn M, Lagerlöf F. Effect of oral iron supplementation on unstimulated salivary flow rate: A randomized, double-blind, placebo-controlled trial. J Oral Pathol Med 2006; 35: 540-7.

[2] Twetman S, Axelsson S, Dahlgren H, Holm AK, Källestål C, Lagerlöf F, et al. Caries-preventive effect of fluoride toothpaste: A systematic review. Acta Odontol Scand 2003; 61: 347-55.

Article in supplement or special issue

[3] Fleischer W, Reimer K. Povidone iodine antisepsis. State of the art. Dermatology 1997; 195 Suppl 2: 3-9.

Corporate (collective) author

[4] American Academy of Periodontology. Sonic and ultrasonic scalers in periodontics. J Periodontol 2000; 71: 1792-801.

Unpublished article

[5] Garoushi S, Lassila LV, Tezvergil A, Vallittu PK. Static and fatigue compression test for particulate filler composite resin with fiber-reinforced composite substructure. Dent Mater 2006.

Personal author(s)

[6] Hosmer D, Lemeshow S. Applied logistic regression, 2nd edn. New York: Wiley-Interscience; 2000.

Chapter in book

[7] Nauntofte B, Tenovuo J, Lagerlöf F. Secretion and composition of saliva. In: Fejerskov O, Kidd EAM,

editors. Dental caries: The disease and its clinical management. Oxford: Blackwell Munksgaard; 2003. p. 7-27.

No author given

[8] World Health Organization. Oral health surveys - basic methods, 4th edn. Geneva: World Health Organization; 1997.

Reference from electronic media

[9] National Statistics Online—Trends in suicide by method in England and Wales, 1979-2001. www.statistics.gov.uk/downloads/theme_health/HSQ 20.pdf (accessed Jan 24, 2005): 7-18. Only verified references against the original documents should be cited. Authors are responsible for the accuracy and completeness of their references and for correct text citation. The number of reference should be kept limited to 20 in case of major communications and 10 for short communications.

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