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Contents

Backpack - Bad Pack an Iisue, Backpack Uusage and its Implications on Indian School Children, an Observational Study on the Impact of Backpack Between Rural and Urban School Children

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ABSTRACT

Objective of the study

To observe the amount of weight carried by the Indian school children and also to identify the complications out of it. This study also focuses on to check whether there is any difference between the school children in the urban and rural area regarding the usage of backpack and its implications.

Methodology

Total of 400 children (207 children from urban school and 193 from rural school) aged between 6 to 13 years from the class II to VIII were selected using stratified random sampling method. Self made questionnaires are filled, which had personal details, physical characteristics and mode of transport, carrying frequency and method of carrying.

Results

The study shows that mean bag weight carried by the urban school children are 7.1 kg which is 17% of their body weight and rural school children are 3.2 kg which is 12% of their body weight. Among the urban school children (n= 201) 62.3% of them are having pain due to backpack out of that 42.55% are having shoulder pain and 19.8 % have back pain. In comparison with rural school children it is only 17% of which 11.4% with shoulder pain and 6.2% with back pain.

Conclusion

The backpack had its impact on the Indian school children, especially the urban school children are affected more when compared with the rural school children, it is mainly because of the syllabus pattern, and extra load in the from of lunch where the rural school children are provided with mid day meal. In addition to the extra load the urban school children have extra curricular activities. It is high time to make a safety guideline to avoid any complication out of backpack.

Introduction

Each school year millions of children walk to, from and around school carrying a significantly greater amount of weight in their backpacks and for a longer period of time. Children have to carry a full day's class schedule of school books, in addition to other items and supplies, through out the day1. The average student carries a backpack weighing almost one fourth of his or her body weight. Three out of 10 students typically carry backpacks weighing up to one third of their body weight at least once a week. Negrini S, Carabalona R, Sibilla P (1999)2 Using a back pack allows a person to carry more items than would be possibly by the arms and hands alone. But the usage of this heavy backpack can injure kids, when a heavy weight like a backpack filled with books is incorrectly placed on the shoulders, the weight's force can pull the person backward1. To compensate this, the person will bend forward at the hips or arch the back which will cause the spine to compress unnaturally.

The heavy weight can cause shoulder, neck and back pain. Kids who walk to and from school are also more likely to suffer back pain from heavy

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packs because duration of use increases the risk of injury3. Musculoskeletal problems were reported by 77.1% of the students. Symptoms were most prevalent in the neck, shoulder, upper back and lower back4. Nonspecific mechanical back pain was found to be highly prevalent, and the reported severity and chronicity of pain where high2. Forward head posture increased when carrying a backpack, especially one with a heavy load5. Carrying a backpack weighing 15% of body weight appeared to be too heavy to maintain standing posture for adolescents6. There is a growing concern that youngsters may have long term back problems from trudging about with such heavy loads. A significant change in the cranio vertebral angle was found at every year level, when comparing standing posture with no backpack posture when carrying a backpack. The change was greatest for the youngest students7. The combined effect of heavy load and position of the load on the body size and shape of the load and load distribution time spent in carrying, physical characteristics and physical condition of the individual were hypothesized as factors which were associated with problems8. A recent study has shown a significant association between spinal pain and heavy backpack weight.

The guideline recommends that backpacks not exceed 10 to 20 percent of the child's body weight (American Academy of pediatrics). American occupational therapy association recommended that a loaded backpacks weigh no more than 15% (about one-sixth) of a students body weight (for a student weighing 100 pounds, this means that the backpack should weigh no more than 15 pounds) Negrini.S, Carabalona.R (2002)9. The American occupational therapy association, American chiropractic association, American physical therapy association and American academy of orthopedic surgeons have similar recommendations to limit backpack weight to 15 percent of a child's weight. There are lots of studies concerning this but little are available targeting the Indian school children. On 8th December 2006, our government has passed a bill, The Children School Bags Limitation of Weight Bill Number LXXXVI of 2006 to provide for limitation on the weight of school bags, duties and responsibilities of the school to ensure the compliance of the limitations so imposed and to there are educated by on this issue. It is high time that in India we have to gather information regarding the weight carried by the school children from various parts of the country both urban and rural school levels. And identify the problem regarding the backpack carried by the school children. This will help the school children, parents and public to realize the real depth of the problem and necessity to make rectification in this issue. So, the need of the study was felt on this issue and observational study was conducted.

Methods

Study design: Stratified random sampling

Participants: A total of 400 children 207 children from urban school and 193 from rural school aged between six to 13 years from the class II to VIII.

Inclusion criteria: Children between 6 to 13 years of age, studying from II to VIII

Exclusion criteria: Children below 6 years and above 13 years

Procedure: The children from both the schools were made to participate in the morning session during the assembly hour. Informed consent was obtained from the respective school headmistress. In this session the children were given a self made questionnaire comprised of 13 questions. The questionnaire consist of personal details like name, age and class, physical characters like height, children weight and bag weight. The subjects weight were measured with a weighing scale accurate to be within 0.1 kg to 120 kg. Standard height was measured with measuring tape secured to the wall the student stood bare foot, chin retracted and eye looking straight ahead. The school bag was also weighed. It also had details of child's mode of transport to school; carrying frequency and method they adopt to carry the bag. It also classified the pain or discomfort is due to bag carriage and how long it will persist and whether they experience the pain only during carrying or even after that.

Statistics: Questionnaires were statistically analyzed by SPSS (version 10.0) software.
Descriptive Statistics N= 207

Components	Mean	Standard Deviation
Height	4.47	0.53
Weight	7.08	1.82
Bag Weight	33.69	10.93

Comparison	Pearson Correlation	P-Value
Height vs Bag Weight	0.529	0.000
Weight vs Bag Weight	0.452	0.000
Class vs Bag Weight	0.585	0.000

Logistic Regression

Components	B	Odds Ratio	P-Value
Height	0.831	2.296	0.02
Bag Weight	0.284	1.329	0.01

Descriptive Statistics N = 193

Components	Mean	Standard Deviation
Height	131.04	12.1
Weight	27.09	23.04
Bag Weight	3.16	1.36
Age	11.36	13.07

Comparison	Pearson Correlation	P-Value
Height vs Bag Weight	0.557	0.000
Weight vs Bag Weight	0.279	0.000
Class vs Bag Weight	0.596	0.000
Age vs Bag Weight	0.205	0.000

Logistic Regression

Components	B	Odds Ratio	P-Value
Bag Weight	0.66	1.934	0.000

Descriptive Statistics N = 400

Components	**Mean**	**Standard Deviation**
Height	129.24	11.15
Weight	30.51	18.11
Bag Weight	5.19	2.54
Age	10.68	9.21

Comparison	Pearson Correlation	P-Value
Height vs Bag Weight	0.101	0.000
Weight vs Bag Weight	.0333	0.000
Class vs Bag Weight	0.197	0.000
Age vs Bag Weight	0.066	0.000
Pain vs Bag Weight	0.53	0.000

Logistic Regression

Components	B	Odds Ratio	P-Value
Bag Weight	0.66	1.934	0.000

Results

The study shows that mean bag weight carried by the urban school children are 7.1 kg which is 17% of their body weight and by rural school children are 3.2 which is 12% of their body weight respectively. Among the urban school children (n =201) 62.3% of them are having pain while carrying the bag out of which 42.55% are having shoulder pain and 19.8 % are having back pain. The mean weight of the children among the urban school is 33.7 and rural school children are 27.1 respectively. The amount of pain level in the rural school (n= 193) is only 17% in which 11.4% of them are having shoulder pain and 6.2 % of them are having back pain. Comparing the urban school to rural school, the amount of bag weight carried by the urban school children are higher and hence pain level in the urban school children are higher (62.35%). Logistic regression method of analysis shows that among the causes, bag weight and height of the children influence the pain significantly. By using logistic regression method for urban (n = 207) height and bag weight influences pain and for rural (n= 193) bag weight alone influences the pain.

Table 1: Cross Tabulation for Class with Pain Category

Class	Pain			Total
	No Pain	Shoulder Pain	Back Pain	
2nd	27 (90.0%)	3 (10.0%)	0	30
3rd	17 (56.7%)	13 (43.3%)	0	30
4th	8 (29.6%)	13 (48.1%)	6 (22.2%)	27
5th	5 (17.2%)	13 (44.8%)	11 (37.9%)	29
6th	7 (22.6%)	16 (51.6%)	8 (25.8%)	31
7th	8 (26.7%)	15 (50.0%)	7 (23.3%)	30
8th	6 (20.0%)	15 (50.0%)	9 (30.0%)	30
Total	78 (37.7%)	88 (42.5%)	41 (19.8%)	207

Table 2: Cross Tabulation for Class with Bag Weight

Class	Bag Weight			Total
	1.00 – 5.00	5.01 – 9.00	9.01 – 13.00	
2nd	24 (80.0%)	6 (20.0%)	0	30
3rd	1 (3.3%)	29 (96.7%)	0	30
4th	1 (3.7%)	26 (96.3%)	0	27
5th	1 (3.4%)	24 (82.8%)	4 (13.8%)	29
6th	0	30 (96.8%)	1 (3.2%)	31
7th	2 (6.7%)	25 (83.3%)	3 (10.0%0	30
8th	0	20 (66.7%)	10 (33.3%)	30
Total	29 (14.0%)	160 (77.3%)	18 (8.7%)	207

Fig 1: Highest pain perceived in shoulder and low back among the urban school students

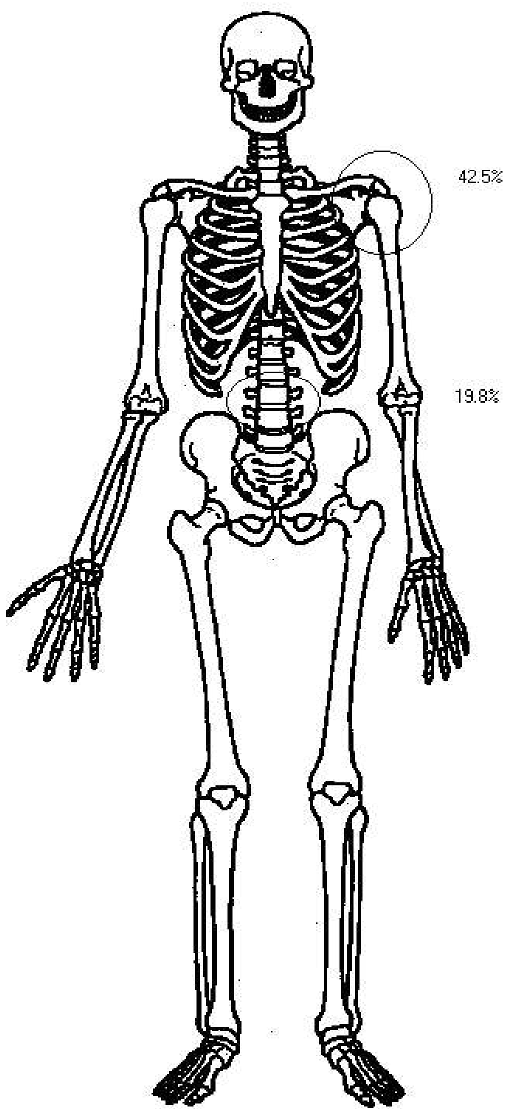
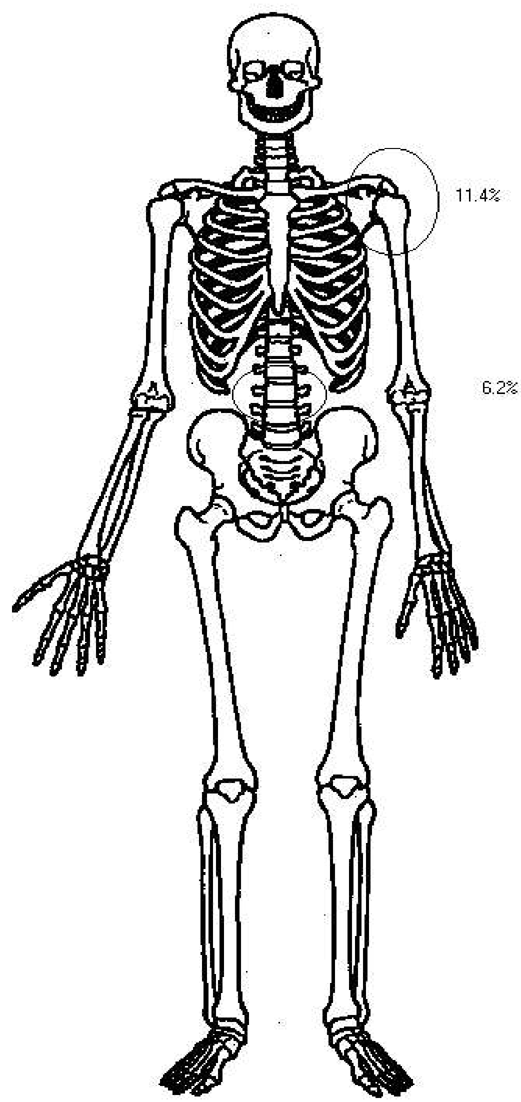


Fig. 2: Highest pain perceived in shoulder and low back among the rural school students



Discussion

As mentioned earlier carrying heavy weight as backpack is the common prevailing problem among the school children worldwide. Many articles have noted the various consequences of usage heavy backpack. Only very few articles are available about the amount of weight carried among Indian school children especially the rural community school children.

The weight of the school bag expressed in percentage of body weight was found to be consistent with studies done by Shruti. R. Iyer and Pascoe et al. They found that Indian children carry school bag weighing 18.5% of their body weight (Shruti. R. Iyer) and in America it was found that mean weight of school bag carried by school children in the age group of 11 – 13 years was 17% of their body weight (Pascoe et al) respectively.

This study supports the prior results that most of the Indian children in the age group of 6 to 13 years of age carried school bag weighing 12% to 21% of their body weight. The rural school children mean bag weight is 12% of their body weight and urban school children mean bag weight is 21% of their body weight.

The mean weight of the school bag carried by the children was found to be 7.1 kg which is 21% of their body weight for urban school children and 3.2 kg for rural school children which is 12% of their body weight. The combined value is 5.2 kg which is 17% of their body weight.

Though the weight carried by the rural school children is comparatively lower to urban school level but is still more than 10% of their body weight and correlate with the pain percentage. Our government has passed a bill on 8th December 2006 which noted that children carrying bags weighing more than 10 percent of their body weight have been found to have poorer lung function. And many recent studies also recommend that bag weight should not exceed 10 % of the body weight. In this study the bag weight carried by the school children are more than 10 percent and the students also reported shoulder and back pain.

The causative factor for the higher level of weight carriage among the urban school children could be excess load in the form of lunch bag when compared with the rural children who provided with free mid day meals in the school. And the variation in the syllabus pattern are also the major factor which make the urban school children to carry lot of books and materials this will add up the bag weight further. The urban school children are also engaged with lot of extra curricular activities which make them to carry heavy loads. The limitation of this study includes that only small population was included and also single school in each category was selected. This study was also not focused on the postural deviation out of backpack usage and information about the way of carrying the bag in detail.

Conclusion

In a study on the effect of backpack education on student behavior and health, nearly 8 out of 10 middle-school students who changed how they loaded and wore their backpacks reported less pain and strain in their backs, necks, and shoulders10. This study also proves that there is a positive relation between backpack and its complications. As the heavy load directly affects the growing child it is necessary to make safety measures to avoid further complications out of it. Risk factors for musculoskeletal discomfort associated with schoolbag carriage include the combined effects of heavy loads, load shape and size, time spent carrying the load and position of the load on the body by addressing all these criteria it is possible to make a solution to this problem.

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The Effect of Cryotherapy on Knee Joint Position Sense

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Study design: experimental design **Purpose:** To investigate the effect of cryotherapy on knee joint position sense. Cryotherapy is commonly used before knee exercises to minimize inflammation & to allow individual to resume activity without pain. But whether it is safe for use before exercise needs to be evaluated**. Setting**: Rehabilitation department, Indian Spinal Injuries Centre, New Delhi.

Subjects: 50 healthy subjects. **Material:** Continuous Passive Motion Machine, Aircast Autochill Cryocuff Unit, Air Splints, Handkerchief, Cotton Gauge, Weighing Machine, Stadiometer, Body marker.

Methods: Two groups were formed, group 1 and 2. Baseline Joint Position Sense (JPS) score were measured at 3 predetermined angles (25^o, 45^o and 60^o of knee flexion) using passive-passive technique, 2nd reading was taken immediately after 20 minutes of cryotherapy (experimental group - group 1) or no cryotherapy (control group - group 2) and 3rd reading was taken after 20 minutes of cryotherapy or no cryotherapy condition. **Outcome Measure: Knee** Joint Position Sense. **Data Analysis:** Statistical tests were performed using the STATA 7.0 and SPSS software. Paired t-test for within group comparison and unpaired t-test for between group comparisons was used. Result: Inaccuracy of JPS increased in all three angles after 20 minutes of cryotherapy ($p < 0.05$). But it did not come back to baseline JPS score even 20 minutes after completion of cryotherapy. Conclusion: 20 minutes of cryotherapy lessens the sensitivity for JPS. These findings may be significant and should be taken into account for therapeutic programmes that involve exercise immediately after a period of cooling.

Key Words: Joint Position Sense, Cryotherapy, Passive – Passive technique

Introduction

Sherrington first defined proprioception in 1906 and is credited with some landmark proprioception experiments. Since then, many researchers have continued his work in an attempt to determine peripheral control mechanism. Sherrington originally defined proprioception as afferent information traveling to central nervous system (CNS) 1. It is currently acknowledged that proprioception is a complex entity encompassing several different components such as the sense of position, velocity, movement detection, and force and that the afferent signals that give rise to them may well have origin in different types of receptors.6 Joint position sense is the ability to determine the location of a joint in space whereas kinesthesia is the ability to detect movement.7

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It is mediated by cutaneous receptors in the skin and proprioceptors in muscles, tendon, ligament and joints, as well as visual and vestibular input which signal to central nervous system (CNS) both the stationary position of the limb and the speed and direction of movement.5 These all inputs can be used on a conscious or unconscious (reflexive pathways) levels so that motor tasks are performed smoothly.7

The most common methods used to quantify proprioception attempt to alter or perturb the afferent information during joint motion. The resultant change in motor output is then used to infer control process .The goal of modification technique is to affect the afferent information while not disturbing the mechanical properties of muscles being tested .1Cryotherapy has become common tool for disrupting afferent signals and modify neuromuscular control while measuring proprioception1 Most proprioception research has examined the elbow, wrist, shoulder and ankle. Some authors have attempted to generalize their findings to other joints; however proprioceptive control may differ depending on the joint tested.1

In the present study our focus is on the joint position sense, defined as awareness of actual position of limb.

Cryotherapy is local application of cold for therapeutic reasons. It is an umbrella term covering several specific techniques. The clinical rationale for the use of cryotherapy focuses on the control of pain, swelling and other negative sequelae of musculoskeletal trauma.8Both physiological and clinical evidence suggest that cold application can reduce nerve conduction velocity, decrease local blood flow and suppress cellular metabolic rate. These effects in turn, reduce the inflammatory reaction to trauma, lessen pain, retard oedema formation and reduce secondary hypoxic injury .4Confusion exist within clinical practice and published literature over the therapeutic benefits and application protocols of cold modalities. This is important clinically because achieving a desired physiologic response by using cryotherapy requires skin tissues to be cooled to specific levels3. Cold induced analgesia begins after the localized skin surface temperature lowers to approximately 13.6ºC. To minimize cellular metabolic rate, skin surface and tissue temperature should be maintained near 10ºC.4

Cryotherapy has been used for the treatment of soft tissue injury in knee joint.The aim of cryotherapy is primarily to reduce the total amount of tissue damage , muscle spasm , swelling , & pain and to reduce the disability time and allow faster rehabilitation after injury.2

Cryokinetics is a rehabilitation procedure that combines cold and exercise following acute joint injury.9 Recurrent studies have shown that the combination of exercise and cryotherapy is effective in the rehabilitation of soft tissue injuries. Cryotherapy is currently used before exercise to minimise inflammation and to allow individuals to resume sports without pain. However, no report has shown the effectiveness and safety of cryotherapy for knee joint before exercise.2.

Cryotherapy before exercise may result in inadequate peripheral feedback for the position sense and may change biomechanic properties of the knee joint, resulting in knee injury when exercise is resumed.2It is important , not only for athletes but also for non athletes , for researchers to present data on the laxity , stiffness , and position sense of healthy knee joint after cryotherapy , so that the effectiveness and safety of using this therapy before resuming sports activities should be clarified.2

The purpose of present study is to investigate whether cryotherapy influences position sense of knee

Methodology

Convenient sample of 50 subjects were included in the study. The study was conducted at I.S.I.C hospital, New Delhi.

All the subjects (n = 50) who met the following inclusion and exclusion criteria were randomly assigned and recruited for the study.

Inclusion Criteria

1. Age: 20 yrs to 30 yrs

2. Right leg dominant

Free from pain and discomfort in

and around their knee .

4. No pathological conditions affecting the musculoskeletal or neuromuscular systems.

Exclusion Criteria

History of back, hip, knee, or ankle injury, surgery or pathology.

2. Systemic involvement

3. Subjects having any contraindications to cryotherapy including area of decreased sensation, areas of decreased blood flow, Raynaud's disease or previous cold allergies or reactions.

Study Design

The study was a pre test post test (experimental) design to measure the joint position sense before and after application of cryotherapy.

There were two groups:

Experimental Group (Group 1): 25 subjects Control Group (Group 2): 25 subjects Group 1 – 20 minutes of application of cryotherapy. Group 2 – No cryotherapy application, just lying for 20 minutes.

The joint position sense score was measured before application of cryotherapy, just after completion of cryotherapy, 20 minutes after completion of cryotherapy.All joint position sense score were measured on the same day.

Instrumentation

1. Continous Passive Motion (CPM) machine – KNEE KINETEC model OPTIMA (Smith & Nephew Kinetec)
2. Aircast Autochill Cryo Cuff unit with knee joint cuff.
3. Air splints (ankle – foot, hip and thigh)
4. Handkerchief
5. Cotton gauge
6. Weighing machine
7. Stadiometer
8. Body marker
9. Watch

Procedure

Subjects received verbal description of all the procedure and were included in the study after informed consent form was signed. The subjects were instructed to remove their trousers and socks and were asked to wear shorts extending not below midthigh to allow for acclimatization to room temperature for 10 minutes.

Thereafter subjects were made to lie supine with right leg on CPM machine. Air splints were applied to thigh, lower leg and foot to be tested to neutralize cutaneous sensations from these areas. After fixing straps, CPM machine was adjusted so that the axis of machine is in line with that of subject's knee joint, defined using lateral femoral epicondyle. Subjects were blind-folded and cotton gauge was given in the ears for preventing any visual or auditory input respectively to joint position sense. All movements were performed on right knee joint.

The knee joint was passively moved from its starting position (0 degrees) to one of the three pre determined joint angles, that is target angles (25, 45, 60 degrees), at a speed of two degrees per second. The knee joint was rested at target angle for five seconds (same durations for all trials) by the investigator and the subject was instructed to remember the position of knee joint (practice 1). The knee was brought back to different randomly assigned starting angle between 10 to 15 degrees from original starting position and rested for 5 seconds; similar procedure was repeated (practice 2). The knee was again flexed with subject instructed to stop the machine with hand held remote to identify the target angle (reading). The absolute difference between preset angle and perceived angle i.e. angle reproduced was recorded.

Absolute Error = ¦ Target Angle - Angle Reproduced ¦

For each of the pre-determined angles, three readings were taken and their mean was taken as the final value of that angle as taken as the final value of that angle.

Data Analysis

This data was analyzed by means of paired t-test for within group comparisons and by unpaired t-test for between group comparisons through SPSS software.

Results

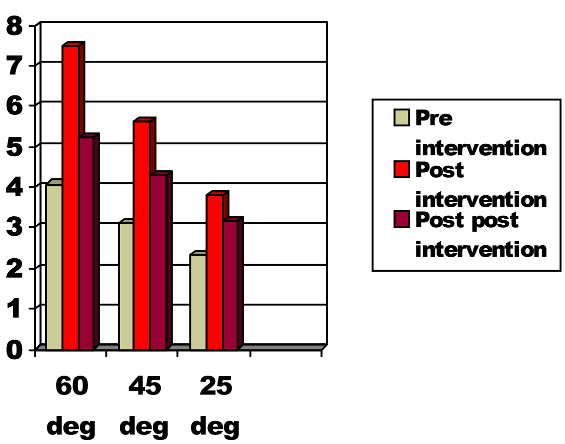
Inaccuracy of JPS increased in all three angles after 20 minutes of cryotherapy . But it did not come back to baseline JPS score even 20 minutes after completion of cryotherapy.

Joint position sense error- within group

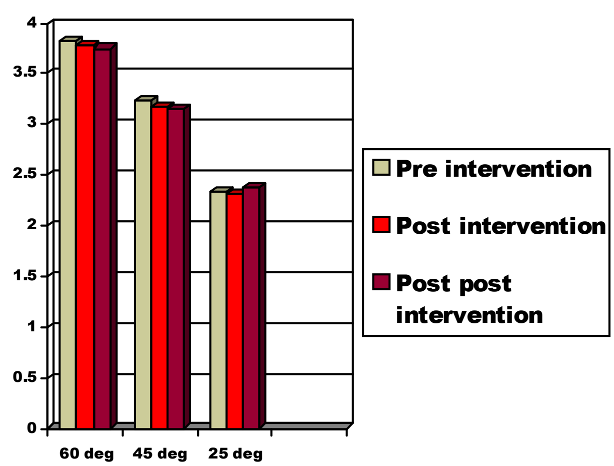
Angle	Pre intervention	Post intervention	Post post intervention	t - value		
				Pre intervention Vs Post intervention	Pre intervention Vs Post post intervention	Post intervention Vs Post post intervention
Flexion 60°	4.08±2.84	7.50±4.62	5.24±2.61	4.58**	3.96**	3.93**
Flexion 45°	3.12±1.59	5.61±3.37	4.28±2.10	4.38**	4.15**	3.90**
Flexion 25°	2.33±1.27	3.81±2.03	3.18±1.59	4.80**	3.98**	4.27**
Flexion 60°	3.82±1.84	3.79±1.84	3.75±1.84	0.49	1.08	0.66
Flexion 45°	3.23±1.69	3.18±1.65	3.16±1.70	0.75	1.07	0.64
Flexion 25°	2.34±1.21	2.32±1.00	2.28±1.04	0.25	0.79	0.96

Note: ** significant at 0.01 level

In graphical representation where x axis is degree of knee flexion (predetermined target angles) and y axis is error in degrees made by subjects at each target angle, experimental group shows significant error in JPS score post cryotherapy and post post cryotherapy at all three angles with maximum at 60° angle of knee flexion. Whereas in control group there is no significant change in JPS score in pre, post, post post test condition at all three angles.



Experimental Group



Control Group

Discussion

There was significant joint position sense error at all target angles after application of cryotherapy, within the group and also between the groups. These effects can be explained neurophysiologically by reference to reduction of nerve conduction velocity (NCV) and eventual blocking of conduction. Abramson et al showed an approximately linear inverse co-relation between NCV and degree of tissue cooling.2Lee et al reported that skin temperatures at which subcutaneous nerves start to show significant reduction of velocity are at approximately 25 degrees celsius and below. Below 15 degree celsius, nerve conduction failure occurs.2

Investigators have reported that monosynaptic reflex amplitude decrease following muscle cooling which points out to decrease in nerve conduction velocity and muscle spindle firing rates as potential causes.9 Jennifer et al reported, with ice pack over the Flexor Carpi Ulnaris, there was marked and progressive reduction in the motor conduction velocity of the ulnar nerve of 11.6 %. The mean velocity from ten subjects was reduced from 52.6 to 46.5 m/s with 24 minutes of icing.11 When the ice was applied to the elbow, there was even greater reduction in conduction velocity to achieve a maximum drop of 29.4 %. Here the velocity dropped from 52.8 to 37.3 m/s with 20 minutes of icing.28 The changes observed in NCV are thought to be caused by a fall in tissue temperature adjacent to the nerve.11Buchthal and Rosenfalck reported that the conduction velocity in human sensory nerve drops about 2.0 m/s/°C change in intramuscular temperature.

Miglietta concluded that intramuscular temperature is reduced after 20 to 30 minutes of cold application.14Above mentioned studies reveal that there is decrease in nerve conduction velocity and eventual blocking of conduction with decrease in tissue temperature. Also, 20 minute cryotherapy is sufficient to lower intramuscular temperature and to affect nerve conduction velocity (NCV).

In addition, the change in biomechanical properties of the knee joint might be attributed to the impairment of the position sense. The motion of a stiffer knee joint might prevent adequate signals from being provided by mechanoreceptors in the knee joint capsule, muscles and ligaments.2In the present study, 20 minutes after removal of cryo cuff, joint position sense is still impaired significantly. It can be explained on the following evidences:

Petajan and Watts reported that rate of cooling is more than the rate of rewarming. Ronald Bugaj also reported that rewarming does not occur as rapidly as cooling. He found the rate of cooling 2.7 degree celsius per minute while rewarming occured at 1.9 degree celsius per minute after 10 minutes of cryotherapy.12 Hartvikren also documented prolonged effect of local cooling. He found that after 20 minutes of cold application, ankle clonus completely disappeared for upto 8 hours. This prolonged effect was attributed to direct cooling of muscle spindle.14

Young Ho Kim documented that since the vasoconstricted subcutaneous fat layer acts as an insulating material during the cryotherapy, temperature of deeper structures changes very little. Therefore, the effects of cryotherapy last longer. In addition, vasoconstriction induced by cryotherapy reduces blood flow, it takes longer for the cold tissue to recover its original temperature.13

In the present study, the measurement of joint position sense has been done by passive- passive method, which is considered to be pre requisite for measuring joint position sense.12 This method has been used by many others to measure joint position sense. Tsang et al reported that the passive knee joint repositioning test produces highly repeatable data, with intra class co-relation of 0.90.5The assessment of proprioception using "Reproduction of passive positioning" is a valid and established method described by Barett.15 To perform passive presentation – passive replication technique, proprioception testing device was used which consisted of motor driven goniometer. The main aim of proprioceptive device was passive presentation to target position. M J Barlett et al and Thatia et al and many other researchers have used CPM machine to measure joint position sense of knee joint.17, 18, 19

A reliable method for the estimation of joint position sense is the measurement of the reproduction of a specific target position, the difference between the target and estimated position being used. Joint position sense is expressed as the absolute error. (AE) The reason for using a passive and non-weight bearing protocol in joint repositioning test was to minimize the motor contribution, which has been found to aid proprioceptive acuity.20

In addition to pre post method selected for the study, control group was also taken, so that if there is any fatigue or practice effect, it can be eliminated by comparing these two groups. Also ipsilateral measurement is preferred to counterlateral measurement of joint position sense20 which has been done in the present study.Because of possible difference in joint position sense in dominant and non-dominant limbs, only the dominant leg was chosen. Kicking a ball was chosen as the test for leg dominance.

Skin temperature was not measured in the present study and it is a limitation of the present study. But Dahlstedt et al have shown effective reduction of skin temperature with use of auto chill cryo cuff unit device as recommended by the manufacturer22.A 20 minutes duration of cryotherapy is commonly used in clinical practice and is sufficient to lower intramuscular temperature21.

Heather et al reported that cooling does not affect knee proprioception. In this study, proprioceptive accuracy and timing were measured by passively moving the knee, then comparing the subject's active reproduction of the passive movement.17 Inconsensus with the result of this study might be due to active reproduction of passive movement, as explained before.Hooper et al showed significant difference in ankle position sense after 15 minutes of ice immersion.2

K.R Grab et al concluded that there remains no comprehensive method for measuring proprioception. The result of studies which use only either joint position sense or kinesthesia test must be interpreted with care23.

Furthermore, the terms proprioception, kinesthesia and joint position sense should not be used synonymously.

Conclusion

The findings of this study do support the experimental hypothesis that cooling knee joint for 20 minutes impairs the knee joint position sense. To avoid the risk of injury, when the exercise is resumed immediately after cooling, this fact should de considered.

Clinical Relevance

Since the present study shows significant effect of cryotherapy on knee joint position sense and knee joint position sense have important role in functional joint stability and motor control administration of exercises immediately after cryotherapy would not be safe. So exercises should not be given immediately after cryotherapy to avoid potential injury.

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Effect of Dual Task on Static Postural Stability in Persons with Parkinson's Disease

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ABSTRACT

Background and Purpose of Study: Patients with Parkinson's disease often need physiotherapy for the management of their gait and balance problems. Dual task performance compromises postural stability in Parkinson's disease which can lead to falls and also deterioration in the performance of the simultaneous tasks, when the attention capacity resources are shared amongst different tasks. The purpose of this study was to observe the effects of performance of secondary motor task and secondary cognitive task on postural stability in persons with Parkinson's disease using clinical steady standing tests, and to further clarify whether the type of task was a major determinant of the severity of dual task interference.

Materials & Methods: It is a randomized experimental study with same subject design. 42 subjects were included in the study selected on the basis of inclusion & exclusion criteria. All the subjects were required to maintain 5 steady stance positions (feet apart, feet together, stride stance, tandem stance, single leg stance) without any secondary task and while doing a secondary motor task (thumb and finger opposition) and a secondary cognitive task (reciting the days of the week backwards) separately. Time spent in each of the positions was recorded using a stopwatch, the maximum time being 30 seconds.

The general Linear Model Repeated Measures Analysis of Variance (ANOVA) was used to examine the changes in the outcome variables under 3 different conditions.

Results: The difference between the mean time duration during the performance of secondary motor task and secondary cognitive task was significant (at $p < 0.05$) in the feet together; stride stance, tandem stance and single leg stance position. This indicated that the performance of cognitive task was more detrimental to postural stability than the performance of motor task in the more difficult stance positions.

Conclusion: The performance of even simple motor and cognitive task resulted in deterioration of postural stability in this study. The cognitive task was more demanding task for the subjects and hence resulted in greater dual task interference and postural instability.

Keywords: Dual task performance, Postural stability, Parkinson's disease.

Introduction

Postural instability is a common and serious problem in Parkinson's disease (PD). Postural reactions of up to 96% of all parkinsonian patients diminish during the course of the disease. Koller and colleagues (1) reported that 38 of 100 patients with PD fall- 13% of them more than once a week – 13% experience fractures, 18% hospitalisation, and 3% are confined to a wheel chair. In addition, social isolation occurs because of the fear of falling. Unfortunately, the effect of dopaminergic medication on postural instability is negligible (2). Furthermore, postural instability is not restricted to late stages of the disease, and it can even be the first presenting symptom.

Postural control has traditionally been considered an automatic or reflex controlled task, suggesting that postural control systems use minimal attention resources. However, recent research has provided evidence against this assumption. These studies suggest that there are

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rehearsing action sequences or consciously attending to maintaining balance while movements are performed. These automatic tasks of maintaining posture or walking may become cortically controlled. So when the patients are asked to perform these tasks along with any other motor or cognitive task, there may be deterioration in either of them indicating limited attention resources.

The effect of concurrent performance of motor and cognitive tasks on postural stability has been studied. Morris et al (14) reported that people with PD performed poorly on a series of standing balance tasks when required to direct their attention towards reciting the days of week backwards. Those who were fallers showed greatest dual task interference. Using multiple tasks test, Bloem et al (15) showed that the number of healthy older people and those with PD who made movement errors increased as the secondary tasks became more complex. Those with PD made the most errors. There is a single study (16) that has seen the effects of both the tasks (motor and cognitive task) on postural stability. The cognitive task was more demanding than the motor task for the PD patients. A study performed on the effect of motor and cognitive task on the gait of PD patients, showed no difference in between the tasks ([17]). Different types of tasks were used in different studies.

The type of secondary task has been shown to influence the degree of dual task interference. This may be due to structural interference if the secondary task competes for similar cognitive resources to the postural task, or capacity issues if the task has a greater attention demand. The degree of interference to either the postural or secondary task is influenced by the individual's prioritization of the tasks. Preferential attention may be instructed or may arise out of the tasks themselves. Greater priority may be given to a task that poses a greater threat to stability than to the concomitant secondary task. Whether the type of secondary task (motor or cognitive) or just the level of complexity of the tasks is a major determinant of dual task interference in people with PD is not clear.

Need and Significance of Study

It is well established that concurrent motor task or cognitive task performance in PD accentuates movement disorders during upper limb tasks and walking, although whether this applies to postural control has not been examined in detail. Though motor task and cognitive task both deteriorate the balance, there is some difference between them. There is scarcity of literature on the comparison of effects of cognitive and motor task on postural stability in PD patients. A study by Roberta Marchese et al (2003) compared the effects of motor task and cognitive task on postural stability in PD patients, which showed greater interference effects of cognitive task on postural stability ([16]).

The therapists should know that how these motor and cognitive tasks differ in their effects on postural stability in PD patients. If there is difference in the effects of motor and cognitive task on postural stability then these two should be addressed separately during teaching the patient strategies to avoid them and even during dual task training.

Purpose of the Study

The purpose of this study is to observe the effects of performance of secondary motor task and secondary cognitive task on postural stability in patients with Parkinson's disease, using clinical steady standing tests and to further clarify whether the type of task is a major determinant of severity of dual task interference.

Statement of the Question

Do the secondary cognitive task and secondary motor task have different effects on static postural stability in patients with Parkinson's disease?

Experimental Hypothesis

Secondary motor task and secondary cognitive task differ in their effects on static postural stability in patients with Parkinson's disease.

Operational Definitions ([18-19])

Postural Stability or balance is defined as the ability to maintain the projected center of mass within the limits of the base of support. Static Postural Stability is the ability to maintain the body in equilibrium during rest. Postural stability as measured in this study is the ability of the subject to maintain the following steady stance positions, each for a maximum time of 30 seconds.

significant attention requirements for postural control, and that these requirements vary depending on the postural task, the age of the individual and their balance abilities ([3-5]).

The mechanisms of postural instability in Parkinson's disease are still uncertain and probably complex. PD patients start at a disadvantage. Their flexed posture means that the center of gravity is not comfortably over the base of the feet. There are problems with motor adaptation; there is loss of anticipatory postural control; co activation of muscles in trunk and lower limbs and reduced limits of stability ([6-10]).

Performance of more than one task at a time may lead to fall in PD patients. Many activities of daily life involve performing several tasks at once, such as talking and walking, or maintaining standing balance while dressing. Although most people are able to perform several tasks at the same time, some individuals experience difficulty, particularly if one is a 'postural task' that requires them to maintain balance and upright stance. The term 'dual task interference' refers to the deterioration in performance that occurs when two tasks are performed simultaneously. People with basal ganglia dysfunction are particularly at risk of severe dual task interference due to the role of this part of the brain in the regulation of the movement automaticity. Iansek et al (11) and Seitz and Roland (12) have described how the motor cortical regions of the frontal cortices play a key role in enabling a person to perform a motor skill during the early stages of motor learning. Once the skill has been practiced to the level that it is well learned, it is relegated to the basal ganglia for control. Thus while basal ganglia enable the motor skill to be executed 'automatically' with the correct speed, amplitude and force for the context in which it is performed, the frontal cortical regions of the brain are free to control other tasks 'on line', such as speaking, arithmetic or doing any other motor task.

In basal ganglia disease, the ability to perform more than one task at time can become severely compromised due to less capacity for movement automaticity (13). In such situations, patients must resort to the use of attention strategies to maintain stability. Attention strategies are cognitive activities such as planning out and mentally

Feet placed 10cm apart.

Feet placed together.

Stride Stance: Feet placed 10cm apart and with the heel of the front foot in line with the toes of rear foot.

Tandem Stance: One foot directly in front of other and toes of rear foot contacting the heel of front foot.

Single Leg Stance: Non-weight bearing leg held 45 degrees knee flexion and hip in neutral flexion and 5 degrees abduction.

Dual Task performance: It is also known as concurrent performance and involves the execution of a primary task, which is the major focus of attention, and a secondary task performed at the same time.

Secondary Motor Task: is defined as any motor activity a subject is engaged in while performing motor task of maintenance of posture, balance or gait. The secondary motor task used in this study is the sequence of thumb opposition to second, third, fourth and fifth digits of the dominant hand.

Secondary Cognitive Task: is defined as a cognitive task, which diverts ones attention from the regulation of primary motor task. The secondary motor task used in this study is reciting the days of week backwards.

Materials and Methods ([14,16-18,20-22])

Sample

42 subjects with idiopathic Parkinson's disease in stage 3 of Hoehn and Yahr disability scale (diagnosed by a neurologist). The study was done at A.I.I.M.S, New Delhi.

Patients who were in Hoehn and Yahr stage 3 of disability, medically stable, were able to stand or walk unassisted for a distance of 10 meters, were able to understand and follow commands (score of 24 or more on Mini Mental Status Examination (M.M.S.E) were included in the study.

Patients with any other neurological condition affecting balance (Cerebellar Ataxia, Stroke, Traumatic Head Injury etc). any painful musculoskeletal or joint problem affecting lower limb with scores of less than 20 on Mini Mental Status Examination, with visual or hearing impairment (if any, then successful use of corrective lenses/hearing aids), on tranquillizers, with postural hypotension or lower limb dyskinesias were excluded from the study.

Sample of Convenience was taken. A signed informed consent was obtained from the prospective candidates before their participation.

Instrumentation and Tools for Data Collection: Foot Print Templates made on coloured paper to align feet in various positions, Digital stopwatch to record time spent in various positions.

Independent Variables were secondary motor task (Sequence of thumb opposition to second, third, fourth and fifth digits of dominant hand) and secondary cognitive task (reciting the days of week backwards). The outcome measures to assess static postural stability are the clinical steady standing tests: Standing with feet 10cm apart; Standing with feet together; Stride stance; Tandem stance and Single limb stance.

Procedure

A demonstration for each test position was given to the subjects prior to testing. Subjects were given the opportunity to practice each test twice before the actual trials begun. Foot print templates were placed on the floor to align the feet in various positions. Subjects stood bare foot on these foot print templates. All the subjects were asked to perform 5 steady standing tests with their eyes open. These tests were: standing with feet 10cm apart; standing with feet together; stride stance (alternately with right and left foot ahead); tandem stance (alternately with right and left foot ahead) and; single limb stance (alternately on right and left leg). The tests were repeated under 3 different conditions: without any secondary task; with a secondary motor task (thumb opposition to fingers tips) and; with a secondary cognitive task (reciting the days of week backwards).

A standard verbal protocol was followed for all the patients in the beginning of each test. The instructions to the subjects while performing the cognitive task were: 'While you balance yourself in this position I want you to say the days of the week backwards out loud as many times as you can until I say stop'. The instructions to the subject while performing the motor task were: 'While you balance yourself in this position I want you to touch your finger tips with your thumb as many times as you can until I say stop'. Initially the subject took some external support to acquire the test position, but at the moment of recording time he stood without support. During these tests, subjects were instructed to keep their arms by their sides. If they began to move their arms to regain their balance they were instructed to retain them to their sides. A stopwatch recorded the time spent in each of the positions.

Each test was concluded if the subject changed their initial stance position, took some external support, stopped performing the task or maintained the position for maximum testing time of 30 seconds.

3 trials were given for each of the positions if the subject could not maintain it for 30 seconds. The best of three trials was taken for data analysis. Adequate rest periods were given in between the testing as per the patients will. The order of the three conditions was randomised amongst the entire group (by lots system).

Data Acquisition

Data was collected during the 'on phase' of Levodopa treatment i.e. after 45 minutes to 1 hour of drug administration. The room for data collection was quiet, warm and well lit. There was one attendant around the patient to support him if he unbalanced himself. Data was recorded in the data collection form along with the other details of the patient.

Data Analysis

The General Linear Model Repeated Measures Analysis of Variance (ANOVA) was used to examine the changes in the outcome variables under 3 different conditions. If there were any significant changes, Bonferroni post-hoc comparison of the outcome variables was performed. The significance level set for this study was $p<0.05$. The software program used for data analysis was SPSS 11.5 and STATA 8.0.

Results

42 patients in Stage 3 of Hoehn and Yahr Scale were included in this study. The subject characteristics are as following (also Refer Table 1). There were 33 male and 9 female patients.

Age (Mean ± S.D = 65.23 yrs ± 4.88 yrs)

Body Weight (Mean ± S.D = 64.14 kg ± 5.47kg)

Disease Duration (Mean ± S.D = 4.88 yrs ± 2.52 yrs) Feet Apart

The difference between motor task (29.8 ± 0.63) and cognitive task (29.45 ± 1.34) was non significant in the 'Feet Apart' position (at $p > 0.05$). (Refer Table 2).

Feet Together

The performance of motor task (27.88 ± 3.01) and cognitive task (27.42 ± 3.29) showed significant differences in the 'Feet Together' position (at $p < 0.05$). (Refer Table 3).

Stride Stance

The performance of motor task and cognitive task showed significant differences in the Left and Right 'Stride Stance' positions (at $p<0.05$). The Mean and S.D values for motor task in 'Right Stride Stance' are 28.21 ± 3.31 and for 'Left Stride Stance' are 28.59 ± 3.48. The Mean and S.D values for cognitive task in 'Right Stride Stance' are 27.73 ± 4.13 and for 'Left Stride Stance' are 28.14 ± 4.35. (Refer Table 4 and 5).

Tandem Stance

The performance of motor task and cognitive task showed highly significant differences in the 'Tandem Stance' position (at $p<0.05$). The Mean and S.D values for motor task and cognitive task in 'Right Tandem Stance' are 11.14 ± 5.94 and 9.35 ± 5.77 respectively. The Mean and S.D values for motor and cognitive task in 'Left Tandem Stance' are 11.26 ± 5.25 and 9.3 ± 5.16 respectively. (Refer Table 6 and 7).

Single Limb Stance

The performance of motor task and cognitive task showed highly significant differences in the single limb stance position (at $p<0.05$). The mean and S.D values for motor task and cognitive task in right single limb stance are 3.09 ± 3.85 and 1.61 ± 2.52 respectively. The mean and S.D values for motor and cognitive task in left single limb stance are 2.73 ± 3.66 and 1.14 ± 2.5 respectively. (Refer table 8 and 9).

Looking at the mean values of tasks, it is evident that cognitive task is affecting postural stability more than the motor task. This supports our experimental hypothesis that motor task and cognitive task differ in their effects on postural stability and cognitive task is affecting balance more than the motor task.

Discussion and Conclusion

This is one of the few studies observing the effects of motor and cognitive task on postural stability. For ease of clarity and understanding, we shall consider and discuss these findings individually.

Concurrent performance of motor task resulted in interference with postural stability in the steady stance positions, except the 'Feet Apart' position. Also, the concurrent performance of cognitive task (reciting the days of week backwards) resulted in interference with postural stability in all the steady stance positions.

In PD, the control of posture becomes a conscious process controlled by motor cortex because of the defective basal ganglia pathways. On the other hand, the sequential finger movement (motor task in this study) also involves the supplementary motor area activation. Similarly reciting the days of week backwards (cognitive task in this study) also requires processing involving the cortex. Therefore, when the primary task of maintaining posture is done along with any secondary task, the performance in either of them deteriorates. This view is supported by other studies also. The dual task interference occurs because of the sharing of attention resources between the two simultaneous tasks (Capacity sharing model of dual task interference). The attention capacity is said to be limited and so when two tasks are performed simultaneously the attention is divided between them. The allocation of attention is dependent on many factors; nature of secondary task and postural task, goal of subject and the instructions given to the subject ([22]).

In this study the subjects were given in instructions to concentrate on continuing the secondary task and therefore more attention was given by them to these secondary tasks, hence the postural stability deteriorated. It was seen that some patients were not at all able to continue with the secondary task, especially during difficult test positions (single limb stance) because at that time maintaining stability might have become their primary goal. This is known as the "posture first" hypothesis.

In the 'Feet Apart' position no significant difference was seen between the 'No Task' and the 'Motor Task' condition because this was an easy position to maintain and so the subjects would have used their attention resources to continue with the secondary task performance.

The second main finding of this study was that the balance deteriorated less while performing the motor task than while performing the cognitive task. Cognitive task was more demanding than the motor task and hence the postural stability deteriorated more during the performance of cognitive task.

The cognitive task of reciting the days of week backwards was a more novel task for the patients than the motor task of thumb and finger opposition; therefore, the cognitive task was difficult to perform and required more attention. The motor task after few repetitions might have become an automatic task for the patient, whereas, the cognitive task performed each time might have required mental processing and thinking and so remained an attention-demanding task. Also that each task was repeated many times by the subjects and so motor learning might have occurred. As the motor task was easy so more learning occurred for it as compared to the cognitive task and this could also be one of the reasons that why balance deteriorated less during the motor task performance. Learning made the task easier to perform.

The cognitive task used in this study was not a pure cognitive task but a verbal-cognitive task because the subjects were asked to say aloud the days of the week. A silent mental task might have showed less significant differences but it is difficult to confirm whether the patient is actually doing or not a silent cognitive task.

Also acknowledging the fact that cognitive decline is present even in early stages of PD, we can say that cognitive task was more difficult. Although the patient's inclusion criteria required MMSE score of equal to more than 24, it can still be argued that Mini Mental Status Examination cannot rule out minor deficits in cognition and especially those that may become evident during dual task performance.

Again the difference in between these two tasks was non significant during the 'Feet Apart' position because it might be an easy position for the patients and so they were able to complete both the tasks.

According to the 'Cross Talk Model' of dual task interference, the motor task and the postural task required the same input and output resources and thus increasing the efficiency of these pathways (22). This might have led to less deterioration in balance along with the motor task performance than along with the cognitive task. Mainly the frontal and temporal cortices of the brain control human speech; posture is regulated by brainstem, spinal, cerebellar and basal ganglia nuclei, with a small amount of cortical input.

The 'Tandem Stance' and 'Single Limb Stance' positions are more sensitive tests to identify dual task interference and are also significant in identifying the differences between motor task and cognitive task. Melzer et al (2001) (24) explained that alterations in base of support and cognitive task had an impact on postural sway in older subjects. Adaptation of postural control to a varying BOS diminishes proprioceptive information from ankle musculature. It has also been shown that amongst the Berg Balance Scale items, the most difficult are the maintenance of standing position with a narrow base of support, turning 360 degrees and standing on one foot ([25-27]).

The results of 'Feet Apart', 'Feet Together' and 'Stride Stance' positions were confounded by the ceiling effects i.e. most of the subjects were able to maintain these positions close to 30 seconds.

The differences in data between the right and left sides of stride stance, tandem stance and single limb stance indicate that PD is an asymmetrical disease.

Discussion of Methodology

There is a single study in PD (16), which has compared the effect of motor and cognitive task on postural stability. That was a posturographic study. Posturography is not commonly used in clinical settings. Therefore the need to correlate this difference in effect with some clinical tests of balance was necessary. Hence, these steady standing tests were used in our study.

Secondly these tests are based on the

assumption that as base of support decreases, the stability demands increase. Therefore, it will help us in still better understanding of the dual task interference and how it depends on the increasing demands of postural and task complexities.

Stage 3 patients on Hoehn and Yahr Scale were included in the study because at this stage the postural instability becomes clinically evident.

Data was collected during the 'on phase' of levodopa treatment in order to diminish or remove the symptoms of rigidity, bradykinesia and tremors that can make the testing procedure difficult.

Patients with lower limb dyskinesia were not included in the study because it might be difficult for such patients to maintain stance.

Patients were ruled out for any significant cognitive deficits, using MMSE, to ensure that they were to understand and follow commands.

The speed of secondary task performance was not taken into account because under normal circumstances, PD patients are likely to trade off velocity for safety and adopt a slower performance.

The tasks used in this study were non-functional; therefore more real world tasks can be used in future.

The variations in the age and weight of the patients do not affect our results because we are comparing the difference between the tasks against the "no task" condition that serves as a baseline data.

The deterioration occurring in the secondary tasks was not recorded in this study.

Comparison With Other Studies

Another study (16) on effect of motor task and cognitive task on balance in PD patients also supports our result. The difference between the two tasks was significant at p = 0.023. This difference was seen when the patients stood with their feet apart. The significance value is more than that seen in our study because they measured postural sway using posturography technique, which is more sensitive than any clinical test of balance.

A study (17) observing the results of both the tasks on the gait of PD patients showed no difference between the two tasks. Both the cognitive (digit subtraction) and the motor (coin transference) tasks used in this study were novel and so might be equally attention demanding. They explained their results using the capacity sharing model of attention and concluded that type of task is not a major determinant of dual task interference.

Thus, in dual task context when postural demands on attention resources are low, secondary tasks that are similarly low in attention demands may not affect postural stability but more demanding secondary tasks might. However, when postural demands are high, even relatively non demanding secondary tasks might adversely affect postural stability.

We would like to conclude our discussion by writing that it is still not clear that whether there is any difference between the two types of tasks or its just that the tasks are arranged in a hierarchy. In order to understand this paradigm in a better way, more clinical research should be done.

Limitations of the Study

The generalisation of the results of this study can be made to the group of patients with moderate to severe degree of Parkinson's disease (stage 3 of Hoehn and Yahr disability scale) and during the "on-phase" of dopaminergic medications and double blinding would have improved the reliability of the measurements further.

Future Research

A wide array of research can be done in this regard. To fully understand the effect of motor task and cognitive task on postural stability and how they differ, we need to study the effects of various types of skilled, non-skilled, complex and simple tasks. Also effect of more real life activities on balance should be studied. Changes in the brain through biochemical or electrophysiological studies might make it clearer that how do different tasks act at brain level. The effect of dual task interference can be studied in brain injured, stroke, cerebral palsy and other patients. Dual task training can be administered to the patients and results be seen.

Relevance to Clinical Practice

Clinical interventions to reduce dual task interference can be divided into rehabilitation to improve the ability to perform multiple tasks, or compensatory strategies, if the underlying difficulty cannot be overcome. For both of these approaches, raising awareness about the problem of dual task interference with the person, their caregiver and other team members is an initial step. Easy changes can make a difference, including altering the environment (ensure good lighting, reduce obstacles) and simplifying the way in which daily activities are performed (sit down to talk on telephone, avoid thinking while taking bath, avoid talking while walking). This approach is important for safety, to reduce the chance of a trip or fall resulting from inability to perform multi-task.

There is very little published for dual task training in balance or gait. In amputees (28) initially dual task interference was seen but after they were given balance re education the interference reduced because the task of maintaining balance gradually became less demanding. It has been suggested in many studies in psychology that dual task interference can be reduced or almost eliminated when both tasks become quasi automatic following a series of practice sessions. However research work is still needed to confirm this in PD patients.

This increased understanding could serve as a basis for the development of new balance retraining programs that focus on training under the context of multiple tasks. The therapist in order to challenge and improve balance could exploit the concept of multiple hierarchies in both postural and secondary tasks. Dual task interference increases with increasing complexity of both the postural task and the second task. So increasing the difficulty of both tasks could be a logical way to progress treatment. Similarly, intervention could progress from performing dual tasks to multiple tasks. The type of secondary task can vary from a cognitive one to a motor task.

Prioritisation is also important in maintaining safety when performing more than one task. This may be asserted initially with conscious control, where attention is diverted away from the postural task for short and then increasing lengths of time, or during more critical phases of balance recovery. Alternatively, changing the prioritisation toward the postural task is required when compensating for dual task interference that is not improving or when safety is the primary concern. Thus it suggests that in persons where postural ability has potential to improve, so can their dual task ability.

Therapists should train newly diagnosed patients of PD for dual task performance with the hope that intensive practice in the early stages might enable them to learn new ways of performing more than one task at a time; however, this is still to be investigated.

These results suggest that dual task interference on postural control occurs in PD patients even during simple motor (sequence of opposition movements of thumb to the second, third, fourth and fifth fingers) or cognitive task (reciting backwards the days of the week). Postural stability was more affected during the cognitive task performance because it was more difficult task for the patients and demanded more attention.

Table 1 Subject Characteristics

	Mean ± S.D
Age	65.23 ± 4.88
Weight	64.14 ± 5.47
Disease Duration	4.88 ± 2.52

Table 2 Comparison Of Tasks In 'Feet Apart' Position

	Mean ± S.D	F value	P value
No Task (NT)	30 ± 0	6.213 (For Repeated ANOVA)	0.003
Cognitive Task (CT)	29.45 ± 1.34		
Motor Task (MT)	29.8 ± 0.63		

NT vs CT = 0.036	NT vs MT = 0.175	MT vs CT = 0.061

Table 3 Comparison Of Tasks In 'Feet Together' Position

	Mean ± S.D	F value	P value
No Task (NT)	28.47 ± 2.36	22.210 (For Repeated ANOVA)	0.001
Cognitive Task (CT)	27.42 ± 3.29		
Motor Task (MT)	27.88 ± 3.01		

NT vs CT = 0.001	NT vs MT = 0.001	MT vs CT = 0.04

Table 4 Comparisons Of Tasks In 'Right Stride Stance' Position

	Mean ± S.D	F value	P value
No Task (NT)	28.5 ± 3.07	11.2 (For Repeated ANOVA)	0.001
Cognitive Task (CT)	27.73 ± 4.13		
Motor Task (MT)	28.21 ± 3.31		

NT vs CT = 0.03	NT vs MT = 0.01	MT vs CT = 0.01

Table 5 Comparisons Of Tasks In 'Left Stride Stance' Position

	Mean ± S.D	F value	P value
No Task (NT)	28.97 ± 2.96	9.872 (For Repeated ANOVA)	0.001
Cognitive Task (CT)	28.14 ± 4.35		
Motor Task (MT)	28.59 ± 3.48		

NT vs CT = 0.005	NT vs MT = 0.01	MT vs CT = 0.039

Table 6 Comparisons Of Tasks In 'Right Tandem Stance' Position

	Mean ± S.D	F value	P value
No Task (NT)	12.71 ± 6.05	89.69 (For Repeated ANOVA)	0.001
Cognitive Task (CT)	9.35 ± 5.77		
Motor Task (MT)	11.14 ± 5.94		

NT vs CT = 0.001	NT vs MT = 0.001	MT vs CT = 0.001

Table 7 Comparisons Of Tasks In 'Left Tandem Stance' Position

	Mean ± S.D	F value	P value
No Task (NT)	12.76 ± 5.63	96.515 (For Repeated ANOVA)	0.001
Cognitive Task (CT)	9.3 ± 5.16		
Motor Task (MT)	11.26 ± 5.25		

NT vs CT = 0.001	NT vs MT = 0.001	MT vs CT = 0.001

Table 8 Comparisons Of Tasks In 'Right Single Limb Stance' Position

	Mean ± S.D	F value	P value
No Task (NT)	4.95 ± 4.2	50.842 (For Repeated ANOVA)	0.001
Cognitive Task (CT)	1.61 ± 2.52		
Motor Task (MT)	3.09 ± 3.85		

NT vs CT = 0.001	NT vs MT = 0.001	MT vs CT = 0.001

Table 9 Comparisons Of Tasks In 'Left Single Limb Stance' Position

	Mean ± S.D	F value	P value
No Task (NT)	4.61 ± 4.17	47.327 (For Repeated ANOVA)	0.001
Cognitive Task (CT)	1.14 ± 2.5		
Motor Task (MT)	2.73 ± 3.66		

NT vs CT = 0.001	NT vs MT = 0.001	MT vs CT = 0.001

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Effect of Neurodevelopmental Therapy in Gross Motor Function of Children with Cerebral Palsy

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Abstract

Background: Neurodevelopmentaltherapy (NDT) refers to those activities that enable the child to practice the perfect skills. These types of exercises are used to improve movement and postural reactions; thereby it improves gross motor function in children with cerebral palsy. The specific objective of the study is to evaluate the effect of NDT in gross motor function of children with cerebral palsy.

Methods: This study is a one group pre test post test design. 10 children with cerebral palsy were selected and assigned in one group. Pretest value of gross motor function was measured on first day of the NDT program. NDT was given three sessions a week, for three months. At the end of the NDT program, posttest gross motor function was measured.

Major Findings: A mean improvement in gross motor function after NDT was 10.84 with SD of 6.84 and the t value of 5.012 was observed in this study. The obtained t value was significant at the level of $p<0.001$.

Introduction

Cerebral palsy is defined as "a disorder of movement and posture due to a defect or nonprogressive lesion of the immature brain" (Bax M C O, 1964).

"Cerebral palsy describes a group of disorders of the development of movement and posture, causing activity limitation that is attributed to non-progressive disturbances that occurred in the developing fetal or infant brain. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, cognition, communication, perception, and/or behaviour, and/or by a seizure disorder" (Martin Bax, 2005).

Cerebral palsy lesion is non progressive and causes variable impairment of the co-ordination of muscle action, with resulting inability of the child to maintain normal postures and perform normal movements (Martin C O Bax, 1980).

Cerebral palsy is classified clinically in terms of the part of the body involved likely monoplegia, hemiplegia, diplegia, quadriplegia and by the clinical perceptions of tone and involuntary movement like spastic, ataxic, athetoid (Robert B. Shepherd, 1995).

The heterogeneous spectrum of clinical syndromes characterized by alteration in muscle tone, deep tendon reflexes, primitive reflexes, and postural reactions (Blasco PA, 1994).

The range of gross motor skill outcomes for specific types of cerebral palsy with the gross motor function classification system (GMFCS) is a better indicator of gross motor functional impairment than the traditional categorization of cerebral palsy that specifies the number of limbs with neurologic impairment (Betty R. Vohr et al, 2005).

Among the scales available for assessing gross motor function in paediatric population, the gross motor functional measure scale is a useful and reliable instrument for assessing motor function and treatment outcome in cerebral palsy (Nordmark E, Hagglund G, Jarnlo GB, 1997).

Lack of isolated or discrete movements and fine motor coordination are delayed in younger able – bodied children as well as in older children with spastic type of cerebral palsy (Sophie levitt, 2004).

Neurodevelopmental / Bobath therapy (NDT)

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was developed by Dr.Karel Bobath and Mrs.Berta Bobath as a "living concept". The NDT approach is not a set of techniques but more an understanding of the developmental process of motor control and the motor components which make up functional motor tasks. (Davis S, 1997).

Large diameter firm ball made of heavy rubber and provide mobile surface that aid in facilitating postural control and postural preparation of the child. The direction in which ball moved and the position of the child on ball can be varied to facilitate movement (Jane Styer Acevedo, 1992).

Methods

Study design

One group pre test post test design – A quasi experimental design.

A group of subjects was selected and a pre test for the gross motor function measures were taken. After that the children would undergo NDT program. After 3 months following NDT post test values for the gross motor function measures were taken. The values before and after the intervention were compared.

Study setting

The study was conducted in the Department of Pediatric rehabilitation, P.S.G.Hospitals an 810 bedded multi specialty health care system, P.S.G.Urban health centre, Ramakrishna mission vidhyalaya (IHRDC), coimbatore among the children with cerebral palsy for experimental group.

Poulation and sampling

The totality or aggregate of all individuals with the specified characteristic is known as population. Sampling refers to the choosing of a sample from a population.

In this study sample children were selected from the cerebral palsy population of Department of Paediatric Physiotherapy, P.S.G.Hospitals, P.S.G.Urban health centre, Ramakrishna mission vidyalaya (IHRDC), coimbatore. Sampling method used is sampling free technique.

Criteria for sample selection

Inclusive criteria

Age 1 year to 8 years.

Spastic cerebral palsy.

Children with monoplegic, hemiplegic, diplegic, quadriplegic types of cerebral palsy. .

Gross motor function classification system levels I, II and III.

Exclusive criteria

Children with contractures and deformities.

Severe mental retardation.

Uncontrolled epilepsy.

Instrument and Too for date collection

The gross motor function measure scale is a disease specific measure for child, consisting of 88 items in five domains (lying & rolling, sitting, crawling & kneeling, standing, walking running & jumping). It scores from 0 to 3 for each item. Total score is calculated by percentile of dimensional score.

Technique of date collection

In this study, the selected subjects were evaluated for gross motor function measure during the first visit. Following the first assessment the patients were administered NDT program (Annexure 5) which aims at improving gross motor function.

After 3 month follow up, assessments were taken at the end of 3 months after the first visit. The treatment duration for a child was 3 session per week into 3 months. The measures of gross motor function were compared before and after the administration of NDT program.

Technique of data analysis and interpretation

Data collected were analyzed using paired't' test to measure the changes between the pre and post test values within the group.

Data analysis and interpretation

Ten children received NDT was assessed with gross motor function measure scale before and after 3 months of treatment. The data are presented in the table and mean, standard deviation and t test were calculated.

In this study 4 female, 6 male children participated and age ranged from 1 to 8 years.

Data interpretation

Paired't' test was used to analyze the significant difference between the mean of the pre test values and mean of the post test values to determine the outcome of the NDT program given after a period of 3 months. The statistical analysis was done for the measures collected by gross motor function measure scale.

From the Table 1, Graph 1and 2 it is inferred that there was gradual improvement in the gross motor function covered by the children after the NDT program. On analyzing the pre test and the post test values by paired 't' test, there is significant mean difference of 10.84 with Standard Deviation of 6.84 and the t value of 5.012 at $p<0.001$.

Results and discussion

The study aims to evaluate the effect of NDT program on the children with cerebral palsy. Among the 10 selected subjects 4 are female and 6 are male children.

The selected outcome measures are gross motor function measure scores. Data are collected at the baseline and 3 months after NDT program. The obtained data is analyzed by using the paired't' test.

Results shows that there is significant improvement in the gross motor function capacity as the calculated t value (5.012) for the gross motor function measure is in the table value at $p<0.001$.

The overall score of the gross motor function measure scale also shows similar trends of improvements. This indicates the change in gross motor function of children after NDT program.

Evidence shows that large number of cerebral palsy children experience gross motor function impairments due to the abnormal movement and postural reactions. This abnormal movement and postural pattern is referred as motor dysfunction. We also know that there are effective interventions for these abnormal movement and postural reactions.

NDT aimed at correcting the abnormality of movement and posture pattern in children with cerebral palsy is being advocated. Effect of such an intervention on health related motor functional capacity is being evaluated in the study. With the obtained results, it is evident that health related gross motor functional capacity is significantly improved.

The gross motor functional measure test is a simple yet an effective measure of gross motor functional capacity. It has been shown that even a unit in cerebral palsy gross motor function is clinically significant.

A significant improvement in gross motor function capacity of cerebral palsy children is evident after 3 months of NDT program in this study.

Improvements in gross motor function measures noticed in this study may be due to the reason that NDT program would have helped to reduce the disease symptoms and thereby improving the gross motor functional status in children with cerebral palsy.

Limitations

Small number of participants

Other activities in school, family and therapy schedule were not controlled.

Recommendations

Based on the outcome of the statistical analysis, it is suggested that the future studies can be modified to accommodate the following changes

To use same form of treatment for other types of cerebral palsy.

Other forms of motor function scales can be used for assessment.

EMG can be used for assessment.

Possible neural mechanism can be studied after NDT.

This study can be done for children with mental retardation also.

Summary and conclusion

Based on the analysis of data it can be interpreted that NDT produces significant improvement. In correlating with literature and statistical analysis, this study concludes that NDT has produced significant improvement in gross motor function in children with Cerebral palsy.

It is evident that such an intervention is effective and it helps in reducing disease symptoms and improves the general functional well being among these children with cerebral palsy.

In the future, further studies regarding NDT program will definitely strengthen growing body of knowledge. Therefore, from the literature available and statistical analysis of the data, it accepted and stated as, “There is significant effect of neurodevelopmentaltherapy in gross motor function of children with cerebral palsy”.

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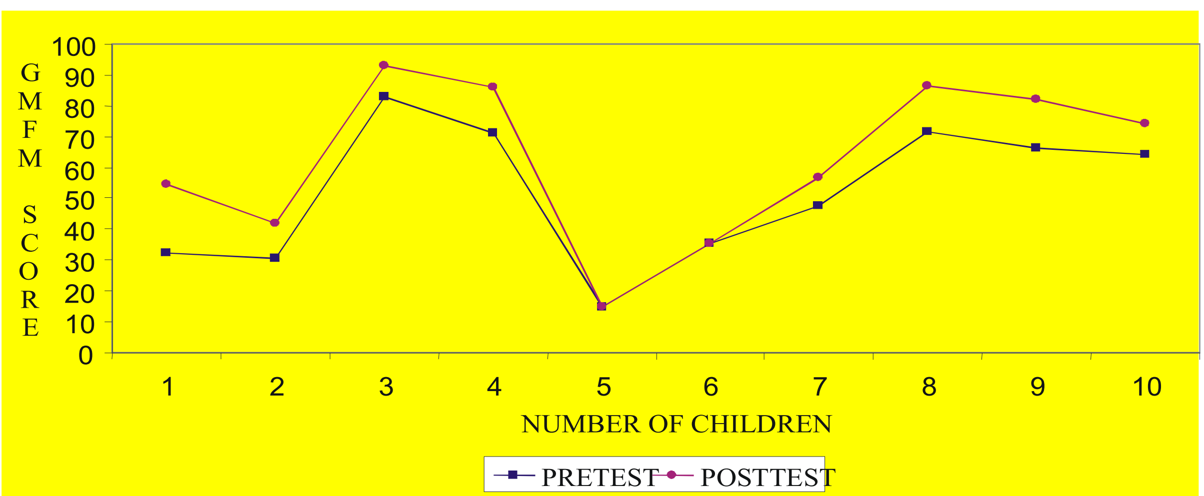
Table 1: Gross Motor Function Measure Sclae (N = 10)

S NO	PRETEST	POSTTEST	DIFFERENCE(d)
1	32.34	54.55	22.21
2	30.48	42.11	11.63
3	83.08	93.02	09.94
4	71.16	86.10	14.94
5	14.94	15.00	00.06
6	35.25	35.40	00.15
7	47.57	56.58	09.01
8	71.75	86.65	14.90
9	66.33	81.89	15.56
10	64.15	74.13	09.98
	Mean=10.84	S.D=6.84	t value=5.012

FIGURE1: GROSS MOTOR FUNCTION MEASURE (GMFM-88)



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Segmentary Relaxation (Stimulation+Biofeedaback) in The Functional Recovery of Hemiplegic Hand

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Abstract

Objective: 1) To examine the efficacy of segmentary relaxation (EMG Biofeedback + Stimulation) compared to conventional occupational Therapy in the Functional Recovery of Hemiplegics hand.

2) To study in which stage of Brunnstrom , segmentary relaxation shows most significant results.

Setting: The study was conducted in the Dept of Occupational Therapy, N.I.O.H, Kolkata.

Design: Experimental group underwent 20 sessions (5 days a week) of Segmentary Relaxation along with Conventional Therapy whereas control group underwent only conventional therapy for the same no of sessions.

Assessments: Upper limb disability was assessed with Action Research Arm Test.Brunnstrom Stage and Goniometric measurement of wrist extension was also recorded.

Results: There was an improvement in the joint range of motion of wrist extension, 2% in control group and 40% in the experimental group. Within group results in the experimental group showed 13.6% improvement in stage 2 to 3 ,14.6% in stage 3to 4 and 40% in stage 4 to 5.The results for ARAT were not significant p=0.24.Chi suare test showed significant results for the treatment effect at p =.02.

Results

There was an improvement in the joint range of motion of wrist extension, 2% in control group and 40% in the experimental group. Within group results in the experimental group showed 13.6% improvement in stage 2 to 3 ,14.6% in stage 3to 4 and 40% in stage 4 to 5.The results for ARAT were not significant p=0.24.Chi suare test showed significant results for the treatment effect at p =.02.

INTRODUCTION:

Rehabilitation of the upper extremity in patients who have sustained a stroke poses a major challenge to therapists. In a review of studies on upper extremity recovery , Gowland stated that only 4% to 9% of patients regained normal function , 23% to 43% regained some useful function and 16% to 28% did not have return of any voluntary movement in upper limb1 .Different treatment strategies for the rehabilitation of hemiplegics patients are available today , such as conventional exercise programs ,PNF, muscle strengthening and physical conditioning programs , neurophysiologic approaches and functional electrical stimulation .Most of these studies have reported that EMG biofeedback can help to achieve improvements even in the chronic state2 .

Feedback is an engineering term defined as a method of controlling a system by re-inserting into it the results of past performance .Among the most expressive therapeutic advances, those relating to spasticity control need to be acknowledge43 . Dimitrijevic and Soroker 1994 studied electrical stimulation effects through a wire–mesh glove on upper extremities of hemiplegics patient’s .The preliminary results indicated beneficial effects such as decrease in muscle hypertonia and facilitation of hand–isolated movements.

Upper extremity hemi paresis is a prominent impairment following stroke and has a significant impact on activities of daily living and quality of life .recovery of upper extremity function is most rapid during the first months after stroke .However, even 3 months after stroke only 20% of stroke survivors have normal upper extremity

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function. Accordingly, the majority of stroke survivors report that impaired upper extremity function is a major problem and this is associated with low level of subjective well being4 . The loss of function in the limb of stroke survivors is the result of lack of inhibition from the higher centers. Some studies (Alfieri,1985:Kraft etal,1995) analyzing FES denoted relief of spasticity and opening of the hemiplegics hand , believing that this fact is due to the mechanism of reciprocal inhibition of the fingers flexion muscles, at the moment when the extensor muscles in hemiplegics patients are stimulated[5] .

There is growing evidence that electrical stimulation has a positive effect on upper extremity motor recovery following stroke. Therefore electrical stimulation might be aw adjunct in the rehabilitation of patients with stroke4. Emg –biofeedback is not a system of treatment in itself, but a technique that can be incorporated into many treatment programmes.

Biofeedback is a specialized form of feedback that provides information directly to a patient about internal biological mechanisms via a sophisticated electronic device. To quote John Basmanjian (the " Father" of EMG Biofeedback), biofeedback is the technique of using equipment (usually electronic) to reveal to human beings some of their internal physiological events ,normal and abnormal, in the form of visual auditory signal in order to teach them to manipulate these otherwise involuntary or unfelt events by manipulating the displayed signals[6].

Feedback may facilitate plastic changes within the central nervous system. Mechanisms that might be invoked include one or more of the following elimination of active inhibitory influences, unmasking of existing pathways to sub serve functions, development of new movement strategies , transfer of function to intact neural structures , use of alternative pathways or sprouting of collateral axons to form new synapses[7].

Electrical stimulation provides effective joint positioning by eliciting activity from weakened or inactive muscle groups. Electrical stimulation has the potential to strengthen these muscles when volitional activation is present.

Electrical stimulation may facilitate neuromuscular re-education as well, the stimulation provides added afferent information to the central nervous system with attention to task and attempts to volitional activation, this afferent input may contribute to neuromuscular re-education of stimulated area8. When the afferent nerve is stimulated, the A alpha fibers are reflex stimulated and as a result the muscle contracts. Initiation of voluntary contraction takes place through primary activation of the small motor neurons to set up a stretch reflex and bring about activation of the alpha neurons[9].

Relatively little attention has been paid to the potential of effect of EMG Biofeedback + Stimulation in the functional recovery of hemiplegics hand Hence this study was carried out to see the effectiveness of EMG Biofeedback +Stimulation for the functional recovery of hemiplegics hand.

Purpose

The purpose of this study was to determine whether there is conclusive evidence regarding the use of EMG Biofeedback + stimulation for improvement in upper extremity function in stroke patients.

Hypothesis

There will be Functional recovery of hemiplegic hand and an increase in the joint range of motion for wrist extension after the application of EMG Biofeedback +Stimulation.

Nullhypothesis:

There will not be any increase in the functional recovery of hemiplegic hand and an increase in the joint range of motion of wrist extension after the application of EMG Biofeedback +Stimulation.

Inclusion criteria

1) Inability to perform voluntary motion in the upper extremity following stroke & significant room for improvement in one muscle group.

2) Relatively uncomplicated history.

3) Workable amount of cooperation and attention.

4) No significant visual and auditory deficits.

5) Significant motivation.

Exclusive criteria

1) Flask hemiplegia.

2) Dementia.

3) Deformity of upper limb.

4) Any incidence of receptive aphasia.

5) Any cardiac problem.

Methodology design

The design is a different subject experimental design.

Setting

The study was conducted in the Occupational Therapy Department of N.I.O.H., Kolkata.

Subjects

A total of 30 subjects with mean age group of 57yrs participated in the study. Subjects were included in the study only after taking individual consent.

Instruments/cales used

1) Biofeedback Instrument

2) Action Research Arm test

3) Goniometer

5) Brunnstrom stage of motor recovery

Assessments:

Basic information of all the patients was taken (demographic data, history, motor evaluation, evaluation of hand function, functional evaluation and ADL evaluation was recorded), for referral. Specific assessments required for the study were Brunnstrom stages of hand recovery, Goniometric measurement for active selective range of motion of wrist, and action research arm test. Subjects were also assessed for the ability to follow simple instructions by administering a part of mini mental status examination.

Experimental group

Experimental group received EMG Biofeedback +Stimulation for wrist extensors and finger extensors. Subjects were also provided with the conventional Occupational therapy.

Control group

Control group received only the conventional Occupational Therapy for 20 sessions.

Procedure

Duration of Treatment

Total of 30 minutes session, 15 minutes each for wrist extensors and finger extensors with a in between phase suitable to the patients compliance to the the program.control group underwent the conventional therapy for one hour each day for 20 sessions.

Treatment

Relaxation

1) Relaxed position is determined, the patient is asked to maintain the reduced EMG activity as he performs various motions with opposite extremity.

2) Conversations with the patient may be used by therapist as a measure of the patient's ability to maintain the relaxed state while his attention is diverted.

3) Patient is asked to maintain a relaxed state during a full passive stretch of the involved muscle.

Position:

Shoulder flexion-10* to 15*

Abduction-20* to 25*

Elbow flexion-10* to 15*

Wrist flexion - l (Maximum)

Finger flexion - Maximum 10

Electrode application:

Select the muscle to be monitored.

Prepare the skin site by cleaning with spirit for application of electrodes over the muscle bellies of wrist extensors and for the muscle belly for finger extensors.

Electrodes spacing is 3.5 cm to 5 cm.

Arc of motion

The wrist extensors and finger extensors were monitored only after relaxation of flexors of the wrist and the fingers .If too much flexor activity was evident, subjects were targeted for smaller arc of motion with success in smaller range of motion, larger arc of motion was aimed.

Parameters

The parameters used for each patient were adjusted to produce the most harmonious movement possible .Width of pulse varied between 100 micro se to 200 micro sec and the frequency varied between 40 hertz to 50 hertz. A long ramp on time is used to avoid activating of stretch reflex in a spastic antagonist.

During the biofeedback session which was in the protocol the patient was asked to contract the wrist extensors and the finger extensors voluntarily

Results

The data was analyzed by spss software. The results indicated an improvement in the joint range of motion of wrist extension, the control group achieved 2% improvement in range in experimental group 25% improvement was seen Not much difference was observed on the affect on improvements in joint range of motion by the stage of recovery. The results are tabulated in Table, Chi suare test was doneto see the effect of the stimulation and conventional therapy.The result was significant at p<_.001(Table-3). .As there was minimum effect on both stages 2 to 3 and 3 to 4 and moderate effect on stages 4 to 5.The nominal values moderate and minimum effect.Titration between three groups were done.The results showed sinificant results for stage 4 to 5 at p<_.02 and for stages 3to 4 and 2 t0 3 the results were insignificant

Table 1

DEMOGRAPHIC AND CLINICAL FEATURES PF SUBJECTS		
	EXPERIMENTAL GROUP(n=15)	CONTROL GROUP (n=15)
Age/yr	57 ± 10.53	57 ± 11.27
Male /Female	13/2	10/5
Duration of stroke (months)	36/09	36/4
Stroke type,inf/hem	7/7	6/7
Side of hemi paresis(R/L)	9/5	9/4

TABLE:2 CORRELATION OF STAGE OF RECOVERY AND WE JROM

N	BRUNNSTORM STAGE OF RECOVERY	% 0F IMPROVEMENT IN JROM OF WRIST EXTENSION
30	2-3	13.6%
	3-4	14.6%
	4-5	40%

Table 3 : Effect of treatment marginal

Group - 1(experimental)	A 15	B 0	A+B 15
Group 2(conventional)	C 7	D 8	C+ D 15
	A+C=23	B+D=7	Grand =30
Chi suare test was done	=5.300, P value = 001		

There remained a tendency for total ARAT score to be improved in the experimental group; however this difference was not statistically significant between the two groups.

P=0.24.

Discussion

The hypothesis that there will be an improvement in the functional recovery of upper extremity in the stroke patients was not justified as the results were not significant at p=0.24. Studies by Lourecao etal leads to conclude that use of FES on upper extremity should be at least for 6 months, when applied twice a week. Probably the duration of treatment was not long enough; this may justify the insignificance in the recovery of upper extremity function. There was an improvement in the joint range of motion of wrist extension in both the groups but the experimental group cited better results. Feedback may facilitate plastic changes within the CNS7 .Basmanjian etal in his study states that studies on new therapy for upper limb function in stroke patients should be done at the ideal stage when the surviving brain tissue has its greatest plasticity i.e. up to 4 months post stroke in patients who show greatest promise. And as most patients in the study did not belong to the acute stage it may be suggested that this may be one of the reasons for the insignificance in the results1 1.

. There was not much difference in the wrist extension range of motion in between the stage group 2 to 3 and 3 to 4. This is supported by Armagaon etal, 2003, who in their study revealed similar results. This may be because electrical stimulation has combination of effects including those at the level of muscle and also a central effect associated with improved motor relearning. However the subjects in stage 4 to 5 achieved 40% improvement2 . Kroon 2005 states although there not direct evidence electrical stimulation provokes motor activation and is associated with cutaneous , muscle and joint proprioception feedback .It may be that patients belonging to stage 4 to 5 get more muscle and joint proprioception feedback which adds to the better improvements in joint range of motion.Chi suare test show significant results for the relation between the dependant and independent variable.P value <_ .001 Wolf 1983 examined the effect of EMG Biofeedback treatment protocol on qualified changes in neuromuscular measures and functional activities among the treatment of 22 cases chronic stroke patients. Its results concluded that EMG Biofeedback can be beneficial in restoring improved upper extremity function among chronic stroke patients6 .Significant results of the expected improvement is supported by the above study by Wolf .The stimulation effects also showed significanr results at p<_.001 ,this is supported by previous study by Wolf 1983.

Conclusion

The study provides conclusive evidence regarding the use of EMG Biofeedback + stimulation for improvement in upper extremity function in stroke patients .The study did not show statistically significant results for ARAT, therefore it may be that the estimated size was small, hence future studies are recommended with a larger sample size. Studies may be conducted to see whether lesion site has any correlation to improvement in upper extremity function and joint range of motion for wrist extension as a result of the therapy.

Acknowledgement

I would like to take this opportunity to thank Dr..Ratnesh Kumar (Director, N.I.O.H), to conduct the study in the institute. I would also like to thank all my friends the staff members. Special thanks to all the subjects Last but not the least I would like to thank my parents and sisters for there immense support throughout the period.

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