PHYSIOTHERAPY AND OCCUPATIONAL THERAPY JOURNAL

Published by ***World Information Syndicate***

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PHYSIOTHERAPY AND OCCUPATIONAL THERAPY JOURNAL

October - December 2008; Volume 1 Number 2

Contents

Closed VS. Open Kinematic Chain Exercises on Gait Performance in Subacute Stroke

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Study design

Randomized clinical trial.

Background & purpose

The goal of this prospective study was to evaluate the efficacy of open vs. closed kinematic chain exercises on gait performance in sub acute stroke patients.

Materials &methods

Thirty patients were randomly allocated in to two groups :open kinematic chain (OKC) group and closed kinematic chain (CKC) group comprising of 15 patients in each of these groups for a 5 week program. Subjects were tested on two measurement scales of functional ambulation profile (FAP) and ink footprint record method on two occasions during the study i.e. prior to the beginning of the rehabilitation program and 5 weeks after the training.

Data analysis &result

Both groups experienced a statistically significant improvement in gait performance by kinematic chain exercises though there were favorable and significant differences between the effects of open kinematic chain and closed kinematic chain exercises. Results show that CKC proved to be more beneficial in improving gait performance as compared to OKCE.

Conclusion

The few significantly better functional results for some of the tested parameters in the closed kinematic chain group suggest that this type of exercise is more effective than the open kinematic chain program in rehabilitation of these patients. Thus this study gives a greater clinical confidence in deciding effective protocol for stroke patients.

Key words

stroke, hemiplegia, gait, kinematic chain exercises.

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Introduction

Walking is a complex motor task. In order that a person can walk, the loco motor system must be able to accomplish four things (1, 2)1. Each leg in turn must be able to support the body weight without collapsing.2. Balance must be maintained, either statistically or dynamically, during single leg stance.3.The swinging leg must be able to advance to a position where it can take over the supporting role.4. Sufficient power must be provided to make the necessary limb movements and to advance the trunk. In normal walking all of these are achieved without any apparent difficulty and with modest energy consumption.

The human walking step is composed of two different phases .The first phase is the swing phase or single support phase when one foot is on the ground while the other swings. This phase begins with the movement of "lift off" and ends with the collision of swing foot with the ground. Swing phase makes up the majority (80 to 90%) of the duration of the walking step in human walking. The second phase is called the double support phase, both foot are on the ground while the body is moving forward. This phase usually makes up only small part (10 to 20%) of the human walking step (4). However in pathological gait all these above factors can be accomplished only by means of abnormal movements with usually increased energy consumption or by the use of walking aids.

The abnormal movements may be performed for one of the 2 reasons: 1. The movement being forced on them by weakness, spasticity or deformity.2. The movement is a compensation, which the subject is using as the correction for

some other problem, which therefore needs to be identified (2, 4).

The gait is often destroyed in patients with stroke (5). "Gregor A Doyle" defined stroke as the neurological deficit involving the cerebral circulation that lasts more than 24 hours. If the deficits resolve within 24 hours it is termed as transient ischemic attack (TIA). The signs and symptoms correspond to the involvement of focal areas in the brain (6).

Stroke is the third leading cause of death in the world and United States after Heart disease and cancer (7). Approximately 600,000 strokes of brain attacks occur in the united states each year and of these, approximately 150,000(25%) are fatal .The incidence of stroke is higher in African Americans than Caucasians. In India stroke is the eighth major cause of death. The reported incidence of stroke in India is about 13 to 33 per 100,000 populations per year. This is comparatively lower than in western countries. (6) Average survival rate for stroke victim is 7 years. There were 4.4 million stroke survivors in 1998.The recovery from a stroke depends on its severity.15 to 30% of survivors remains permanently disabled.14% of those who have a first stroke or a transient ischemic stroke (TIA) will have another within one year (8).

Independent walking after stroke has been reported as varying form 26.7% to 75%. Dickstein and colleagues found that at discharge 50.3% of their patients were able to walk independently, with 44.2% requiring the use of a walking aid. It has been established that 53.3% of a group of 368 stroke patients were able to walk independently indoors after 8 weeks. A study of stroke outcome using a motor relearning program for stroke reported 3% of patients reported on improved walking performance and 61.5% of these patients were able to walk independently for a minimum of 3 meters (9).

The quarters of stroke occur in region supplied by middle cerebral artery .MCA is the most common site of occlusion in stroke. (11) The most common characteristics of MCA syndrome are contralateral spastic hemiparesis and sensory loss of face, upper extremity and lower extremity along with contralateral agnosia, hemianopia ,hemiplegia and dysphasia.(12)

A majority of stroke patients are able to walk but their gait is characterized by low velocity, low cadence, short stride length, increase double support phase and asymmetrical single limb support phases. They commonly have a decreased stance time on their affected leg and consequently short time on their affected leg and consequently a short step length with their non-affected leg. This implies an impaired ability to generate an appropriate support movement on their affected leg during single support, thus decreasing the opportunity to step forward with a non-affected leg. (9). Stroke represents a major health crisis for patient and their families. Ignorance about the cause of the illness on the recovery process and misconceptions concerning the rehabilitation program and potential outcomes can negatively influence coping responses and progress in rehabilitation. (12) The ability to walk is the prime factor that determines whether patient will go home or to a nursing home or whether he or she will return to the previous level of productivity after stroke. The goals of rehabilitation should be focused on retaining the ability to walk. (14, 15)

In mild cases, the damage is not extensive, which enables patient to start gait training immediately after stabilizing their medical condition. After finishing the rehabilitation program, some anomalies in gait remain in some patients, whereas in other patients there are no anomalies in gait. In-patient with severe involvement, which refers to the extent of impairment as a consequence of central nervous system lesion size. These patients often bed ridden for a prolonged period of time. Muscle weakness due to inactivity and disturbed muscle control are usually accompanied by balance problems, disturbances in proprioception, contractures in joint; cognitive dysfunction, aphasia and emotional liability. In such patients, the relearning of gait is very difficult and long lasting. These impairments are related to the inability of hemiparetic patients to walk in normal fashion. (5)

Many treatment strategies for stroke rehabilitation have been suggested though the choice of appropriate program remains uncertain. Earlier it's been known that stroke rehabilitation in spastic condition reinforces the abnormal pattern of posture and movement and

increase spasticity. Although weakness also contributes to movement dysfunction after stroke, it has been feared that heightened activity level during strength training will further exacerbate the abnormal tone imbalance present in spastic hemiplegia. Moreover findings suggest that spasticity does not increase with training of synergies or strengthening of paretic muscles nor does muscle strengthening cause any decremented effect. Infact, several studies show that strength training can be beneficial to patients in stroke rehabilitation. (16)

Patients and therapists have recognized muscle weakness as the limiting factor in the motor rehabilitation of patients after stroke. (11) Muscle strength of paretic side, however unlike spasticity has been shown to correlate with performance of functional activities, most notably gait. To be more specific it is correlated with gait speed, cadence, independence and distance. (18) Muscle weakness is reflected by the inability of the patients with spastic hemi paresis to generate normal levels of muscle force.

Many studies revealed that a program of muscle strengthening proved beneficial for improving the gait in performance of stroke subjects. Moreover, the independence of gait performance on the function of the affected limb suggests that greater consideration should be directed to the planning of exercises for stroke patients.

A common error in developing an exercise program is failure to assess the proximal and distal segment of entire extremity or kinetic chains during the rehabilitation program. (18) Kinetic chain exercises (open or closed) have been significantly advised during an exercise regime, whether for rehabilitation purposes or for strengthening purposes.

Open Kinetic Chain is an exercise or movement pattern where the distal aspect of the extremity is not fixed to an object and terminates free in space. Typically, open kinetic chain exercises are characterized by a rotatory stress pattern at the joint. Additionally, OKCE movements are typically non-weight bearing exercise. (17,19) OKCE and movement patterns also allow more isolated muscle activation (Palmitier Et Al 1991) because such a limited amount of muscular co.contraction is inherent in these exercise movements. (17,19)

Closed Kinetic Chain is an exercise or movement pattern where the distal aspect of the extremity is fixed to an object that is either stationary or moving. These exercises are typically weight-bearing exercises. This is a multijoint movement.There are several prevalent theories that emphasize that CKCE are functional and Create a co-contraction; particularly in lower extremity because they closely simulate the actual movement patterns encountered in daily activities while OKCE are more of non-functional. (17,19)

Researches have been performed indicating the significant functional improvement following OKC or CKC exercise program respectively. Still there is lack of studies emphasizing on the effect of OKCE and CKCE and gait parameters in sub acute stroke thus initiating further research for establishing an effective rehabilitation program.

The aim of the therapeutic interventions in stroke rehabilitation are directed towards improving the strength and co activation of paretic muscle groups which in turn proves beneficial in improving the gait performance of stroke subjects.

Since studies done on open and closed kinematic chain exercises shows improvement in gait parameters by improving the strength of weak paretic muscles. There is need doing more research in comparing the effect of closed and open kinematic chain to find out which of these elicit better gait improvement, which will help in establishing an effective rehabilitation protocol.

Hypothesis

Alternate Hypothesis

There will be differences in the effect of open and closed kinematic chain exercises in improving gait performance in sub acute stroke patients.

Null Hypothesis

There will be no differences in the effect of closed and open kinematic chain exercises in improving gait performance in sub acute stroke patients.

Review of LIterature

Walking is possible for the majority of patients

following stroke, but it rarely return to normal. The gait of people following stroke is characterized by problems with generating, timing and grading of muscle activity, hyper tonicity and mechanical changes in soft tissues. Gait speed, stride length and cadence are lower than normal values.

Common kinematic deviations during the stance phase of gait cycle are :(20)

1. Decreased peak hip extension angle.
2. Decreased lateral pelvic displacements
3. Change knee extension
4. Decreased plantar flexion angles.

Common kinematic deviations during swing phase of gait cycle are (20)

1. Decreased hip flexion
2. Decreased knee extension
3. Decreased dorsiflexion.

During the preswing phase there was a delay in the initiation of flexion of hip followed by delay in flexion of hip and knee as well as dorsiflexion of the ankle progressed only slightly during the swing phase. The duration of the preswing phase was prolonged for patients who had the slowest gait velocity related to normal values stroke gait is characterized by low velocity, low cadence, short stride length, increased double support phases and asymmetrical single limb support phases (21). There were also abnormal movements of upper extremity, the trunk, the pelvis and lower extremity on the unaffected side in an effort to compensate for the decreased velocity on the hemiplegic side (15). Several studies of the characteristic of the movement patterns of gait in hemiparesis have been undertaken; only few have been directly concerned with the disturbed control of muscle activation. Surface electromyograms taken from different leg muscle during walking have suggested a low degree of activity in general both in paretic and non paretic limb. The average EMG activity in four muscle group of paretic leg in different phases of the gait, found more complex changes. Thus in gastrocnemius muscle low average level of activity were found in all the different phases of gait cycle, but in the other muscle examined, average level of activity were decreased in some phases and increased in others. Researches have classified muscle activation problems into the following categories (23):

Variables Affecting Gait

Walking is a complex motor task. Effects on ambulation of variables such as gender, age; standing balance and lower extremity muscle strength have been examined in healthy persons (24,25). After CVA changes occur that may influence a persons capacity to walk. Also change may be the relationship between specific variable and ambulatory status (gait) after stroke (1). Also a research done on 327 persons to establish the relation between age, gender, initial neurological deficit, stroke location, prior stroke, hemisphere of stroke and functional outcome in ischemic stroke have found that positive functional outcome were significantly related to the absence of prior strokes, a younger age, a less severe initial neurological deficit, stroke involving neurological structure and dominant (left hemisphere) lesion (10).Richard W Bohannon found that the gait speed can be expected to be reduced in individuals of greater age and lesser height and lower extremity muscle strength (3).

Bohannon and Andrews confirmed that gait performance is correlated with measures of knee extensor muscle torque (KET) but not spasticity in stroke patients. To be more specific muscle strength of the paretic side, whether indicated by force torque measurements has been found to correlate positively and significantly with gait speed, cadence, appearance, and independence and distance (18). Bohannon found that the body weight, normalized strength of four individuals paretic muscle groups (hip extensors, knee flexors, ankle plantarflexors and dorsiflexors) were correlated with both ambulation speed and cadence in 20 hemiplegic stroke patients. Standing balance has been identified as a predictor of ambulatory capacity (1). Weight bearing ratio was correlated negatively with gait cadence and appearance. Motor control demonstrated a highest correlation with gait measures. As alternating lower limb movements were faster gait performance was better. The normalized total strength of muscle of paretic side correlated significantly and with each gait measurements.

Thus patients who were stronger on their involved side tend to walk better.

Enrique Viosca et al investigated the walking recovery in post stroke subjects using Barthel index and new functional classification scale. Improved walking capacity is detected through out the follow-up process, with a new classification scale but not with barthel index. Patients experienced an improvement in walking recovery throughout the first year after their stroke. The early weight bearing capacity of the affected leg and standing balance were associated with highest walking levels one year after the stroke. (10) Achievement of independent gait is a primary goal for many patients after stroke. It has been found that within 1 week of acute stroke 20% of surviving patients will probably walk normally, but that 20% of patients will be unable to walk without help at 6 months. Wade and associates observed that 81% of long standing stroke patients was independently mobile 6 months after stroke. It has also been reported that stroke survivors who do walk have significantly slow walking speed than normal. (14,26)

Roth Elliot J asserted that velocity is an effective indicator of degree of gait abnormality. he found that velocity is significantly correlated with cadence, mean cycle duration, hemiplegic limb stance phase duration, non hemiplegic limb stance phase duration and percent, non hemiplegic limb swing/stance phase ratio and swing phase symmetry ratio ,velocity is related to most leaving some of the temporal measures of hemiplegic gait.(27) among the time distance parameters, velocity was found to progress first and their after in a descending order, stride length, distance, symmetry, double support time and stance time.(3,7)

Human locomotion is a biomechanical expression of adequate neuromuscular disability. Quantitative evaluation of gait can be done by functional ambulation profile, which provides a practical clinical test of locomotion skill. This profile can be used with severely disabled or mildly afflicted person (28). Titianova studied the gait characteristic and functional ambulation profile (FAP) in patients with chronic unilateral stroke and found the FAP scores of patients reflected well their characteristics spatio- temporal gait variations. However the FAP score seemed a reliable measure of gait abnormality / normality in gait. (29)

Unlike traditional qualitative gait assessment tool ink foot record permits clinically feasible method for assessing temporal – distance parameters (TD) like step length, stride length, cadence and velocity. This provides easy quantification of change and comparison of outcomes across different subjects or treatments. TD values can be measured reliably by this method who have received only a minimum training. inter-rater reliability of this high. The significant relationship of velocity, cadence, step length and SL: LEL to functional ambulation supports the validity of their use as an outcome measure. (30)

Improvement of gait is the most frequently stated goal in stroke patients. Various approaches to stroke rehabilitation, such as facilitation techniques including (1) Proprioceptive Neuromuscular Facilitation techniques (PNF), (2) Brunnstrom's approach (neurophysiologic approach) (3) Bobath approach

(neurodebvelopemental technique), (4) Therapeutic electric stimulation,(5) Electroomyographic biofeedback,(13) (6) Intensive rehabilitation therapy, (7) Constraint induced therapy have been studied to improve the functional recovery of hemiplegia due to brain damage. Specifically there is insufficient evidence that these techniques are superior to conventional exercise therapies. However functional improvements seen with intensive rehabilitation therapies, repetitive training of isolated movements and constraint induced therapy have suggested that therapeutic exercise that includes facilitation techniques may improve motor function of hemiplegic limbs if the facilitation techniques are of adequate intensity and quality and specially if they involve repetition of voluntary movement to be recovered. (31)

Several studies shown that strength training can be beneficial to patients in rehabilitation. (29,39) A short program of task -specific strengthening exercise and training for children with cerebral palsy, run as a group circuit class,

resulted in improved strength and functional performance that was maintained overtime. Similarly a short clinically feasible home based training program can lead to lasting changes in the strength of key lower limb muscles that may impact on the daily function of young people with cp. (32)

'Sauvage Jr' found that appropriately designed high intensity program can result in significant although limited improvements for clinical mobility scores, strength, muscular endurance and certain gait parameters (33) .the pattern of motion of lower extremity on the hemiplegic side had a stronger association with the clinical severity of the mu8scle weakness than with the degree of spasticity, balance control or phasic muscle activity. There were abnormal pattern of motion, which altered the velocity, the length of the stride, the cadence and all phases of gait cycle. As velocity improves these abnormal movements decreased. Therefore the goal of therapy should be to improve muscle strength and coordination on the hemiplegic side especially during the preswing phase. (14,15)

'Teixeira-Salmela' evaluated the impact of the combined program of muscle strengthening and physical conditioning on gait performance on subjects with chronic stroke. Gait analysis revealed that the 10 week training resulted in significant increase in gait speed with improvement in walking patterns as determined by increase in selective kinematic and kinetic measures. After training subjects were able to generate higher joint movements and higher level of power produced by major lower extremity muscle groups. (22,34)

Kinematic chain is a series of interrelated joints that constitute a complex motor unit, constructed so that motion at one joint will produce motion at other joints in a predictable manner. Various kinematics describes the appearance of motion, kinetics involves the forces, whether internal (muscle contractions or connective tissue restraints) or external (e.g. gravity, inertia or segmental masses) that affect motion.

In a closed kinematic chain exercises, the terminal or distal segment is opposed by "considerable resistance" .In an open kinematic chain exercise, the distal segment is free to move without any external resistance. (35) In rehabilitation CKC activities we used to restraint joints and muscle proprioceptors to respond to sensory inputs.CKC stimulate proprioceptor, joint stability, increased muscle co activation, allow better utilization of the said(specific adaptations to imposed demands) principle and permit more functional patterns of movement.

In contrast, OKC exercise can isolate a specific muscle groups for intense strengthening and endurance exercises. In addition they can develop strength in very weak muscle that may not function properly in a CKC system because of muscle substitution .OKC may produce great gains in peak force production and are usually limited to one joint in a single plain (uniplanar) and have greater potential for joint shear.

'Koch' states CKCE produces a minimal amount of shear force, while OKCE produces a greater amount of shear. When the knee is extended during kinetic chain exercises there is a strong contraction of the quadriceps .he found that with CKCE there is a co contraction of quadriceps and hamstrings which reduces force placed on knee by stabilizing the knee joint.

OKCE produced more rectus femoris activity while CKCE produced more vastii muscle activity. Tibiofemoral compressive forces was greatest in CKCE near full flexion and in OKCE near full extension. Peak tension in PCL was approximately twice as great as in CKCE and increased in knee flexion. Tension in ACL was present only in OKCE and occurs near full extension. Patellofemoral compressive force was greatest in CKCE near full flexion and in the mid range of knee extending phase in OKCE. (35)

Significant improvement in strength and functionality as a result of both OKCE and CKCE exercise program was maintained over a period. (37) Long-term prognoses of patients who are managed conservatively with an OKC and CKC exercise protocol are relatively good. Maintenance of the quadriceps strength is a notable findings because it's been emphasized the importance of a good quadriceps function as a premise for a good functional result. This relationship between locomotor function and quadriceps strength were already emphasized

by 'powers'. (37)

'Norris K.D' et al in his study on 5 cerebral palsy subjects out of which 3 utilized OKC training and 2 CKC. He found significant functional improvements for all OKC and 1 CKC studies. His literature indicated both CKC and OKC strengthening exercise improve function in children and adolescent with spastic cerebral palsy but he was unable to conclude which mode of exercise is more effective. (38)

Judicious thought should be given in choosing the exercises for rehabilitation. Decision should be made related to which exercise best meet the intended goals of the rehabilitation or conditioning program.

Methods

Subjects

Number

30 sub acute stroke patients (15CKCE-15 OKCE).

Source

The research has been conducted in the following hospitals.

1. King George Medical College , Shahmina road, Lucknow .
2. Ram Manohar Lohia hospital Lucknow .
3. National hospital, Rajajipuram Lucknow.
4. Jain Dharmarth Chikitsalaya. Yahiyaganj, Lucknow

Inclusion Criteria

1. Age 40-60 years.
2. Able to ambulate independently without walking aids.
3. Oriented and ability to communicate independently. i.e. mini-mental scale scoring >24.
4. Sub acute stroke patients (3 months post stroke).
5. Full range of motion in hip, knee and ankle.

Exclusion Criteria

1. Any associated medical problem.
2. Any high-risk cardiovascular disorders.
3. Any sensory deficits.
4. Spasticity >1 modified ashworth scale.
5. Visual impairments and upper limb impairment.

Sampling

Sample of convenience of 30 subacute stroke patients has been taken.

Instruments and Tools Used

Measurement Tools

- Functional ambulation profile.
- Ink footprint record method.

Materials Used

- Ink
- Stop watch
- Marking pen
- Marking tape

Procedure

Design of Study

Randomized control trial.

Methodology

Subjects were tested on two measurement scales of functional ambulation profile (FAP) and ink foot-print record method on two occasions during the study i.e. prior to the beginning of the rehabilitation program and 5 weeks after the training for comparing the pre and post condition of the subjects.

In FAP patients were assessed on all the three phases, progressing from static bilateral stance through independent ambulation. In each case, the subject was asked to hold the position as long as he could or until 60 seconds had elapsed. The time was measured with a stopwatch.

Each exercise in both (OKC and CKC) training groups was repeated for 3 sets of 10 repetitions .the patients rested for 1 min after the conclusion of each set. Exercises are given for duration of 5 weeks, 3 times a week for 30-45 minutes in the okc exercise protocol, each exercise was held isometrically for count of 6 seconds with a 3 seconds rest between repetitions. Each exercise in the CKC protocol was performed dynamically with 3 seconds between repetitions. The exercise protocols were as follows:

The exercise program for OKC exercise group was:

- Maximal static quadriceps contractions (quadriceps setting) with the knee in full extension.
- Straight leg raising with the patient in the supine position.
- Leg adduction exercises in the lateral decubitus position.

The exercise program for CKC exercise group was:

- Double or single one-third knee bend.
- Stationary bicycling
- Step up and down exercise.

5 -Weeks Follow-up

28 of the 30 patients attended the 5-week intervention program. Two (one from each treatment group) of these 30 patients left the treatment in between because of another attack of stroke during this period. Therefore, the results of these patients were not used in the statistical analysis of this follow- up study.

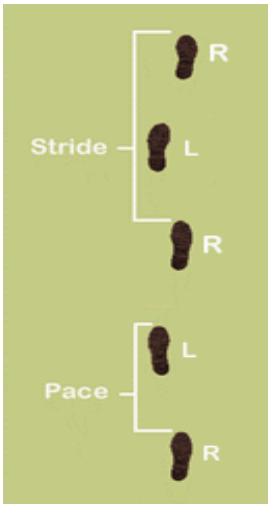


Figure 1: Stride and step length

Figure 2: Stride and step length

Figure3: Static quadriceps contractions

Figure 4: Straight leg raising

Figure 5: Leg adduction exercises

Figure 6: Double one-third knee bend.

Figure 7: Single one-third knee bend

Figure 8: Stationary bicycling

Figure 9: Step up and down exercise.

Data Analysis

Statistics was performed using STATA 15.0 and SPSS software. T test was used to analyse the difference between the performance of the subjects in the two groups A and B before and after the intervention.

TABLE 1: FUNCTIONAL AMBULATION PROFILE OF TWO GROUPS

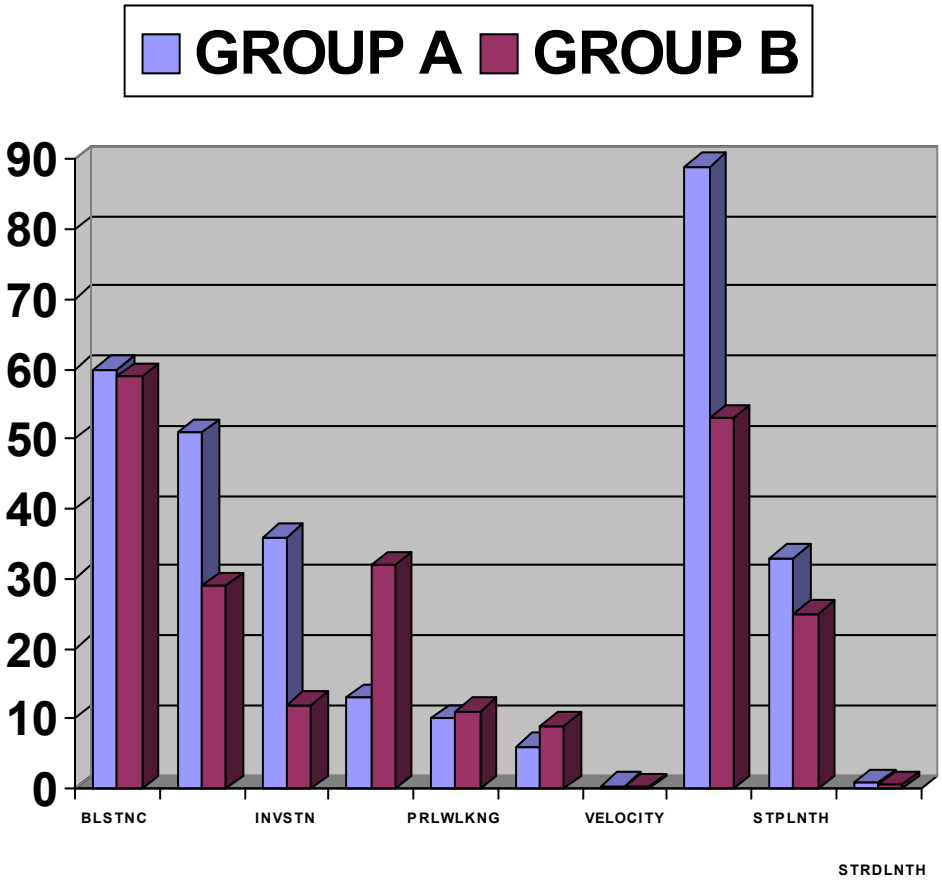
VARIABLES	GROUP A (N= 14)		GROUP B (N=14)	
	MEAN	S.D.	MEAN	S.D.
BLSTNC	60.00	00.00	59.07	3.47
UNINVSTNC	51.92	11.15	29.07	16.42
INVSTNC	36.07	20.52	12.78	11.87
WtTFR	13.50	04.20	32.00	18.01
PRLWLKNG	10.00	10.45	11.14	11.64
INDWLKNG	06.78	07.11	09.00	± 09.40
VELOCITY	0.372	0.084.	0.3050	0.045
CADENCE	89.28	11.53	53.35	19.39
STPLNTH	32.07	06.42	25.14	04.84
STRL by Leg LNTH	00.77	00.13	00.48	00.16

Table: 1. BLSTNC:-BILATERAL STANCE; **UNINVSTNC**: - UNINVOLVED STANCE; **INVSTNC:** INVOLVED LEG STANCE; **Wt TFR: -** WEIGHT TRANSFER; **PRLWLKNG**: - PARALLEL BAR WALKING; **INDWLKNG**: - INDEPENDENT WALKING.

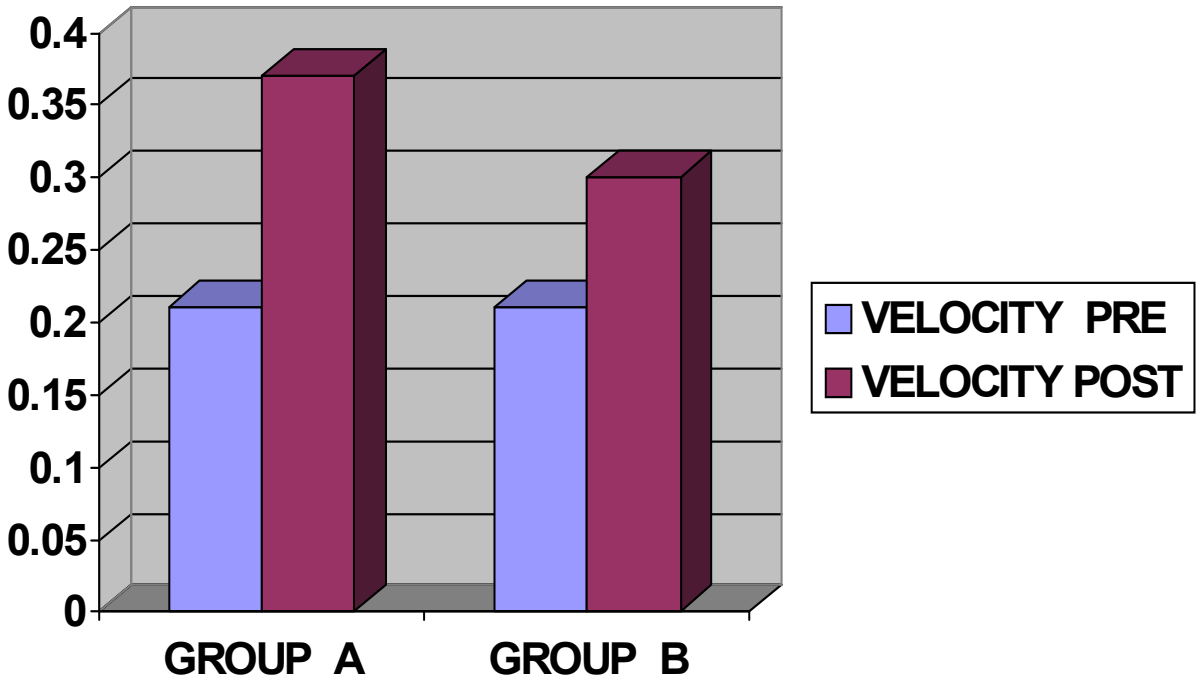
TABLE 2: GAIT PARAMETERS OF TWO GROUPS

VARIABLE	GROUP A		GROUP B	
	PRE INTERVENTION	POST INTERVENTION	PRE INTERVENTION	POST INTERVENTION
VELOCITY (m/sec)	00.21 ± .047	00.37 ± 00.08	00.21 ± 00.03	00.30 ± 00.04
CADEMCE (steps/min)	47.57 ± 09.76	89.28 ± 11.53	40.64 ± 16.79	53.35 ± 19.39
STEP LENGTH (cm)	22.35 ± 03.89	33.07 ± 06.42	17.28 ± 03.98	25.14 ± 04.84
STRIDE LENGTH/ LEG LENGTH RATIO	00.55 ± 0.155	00.77 ± 00.13	00.35 ± 00.08	00.48 ± 00.16

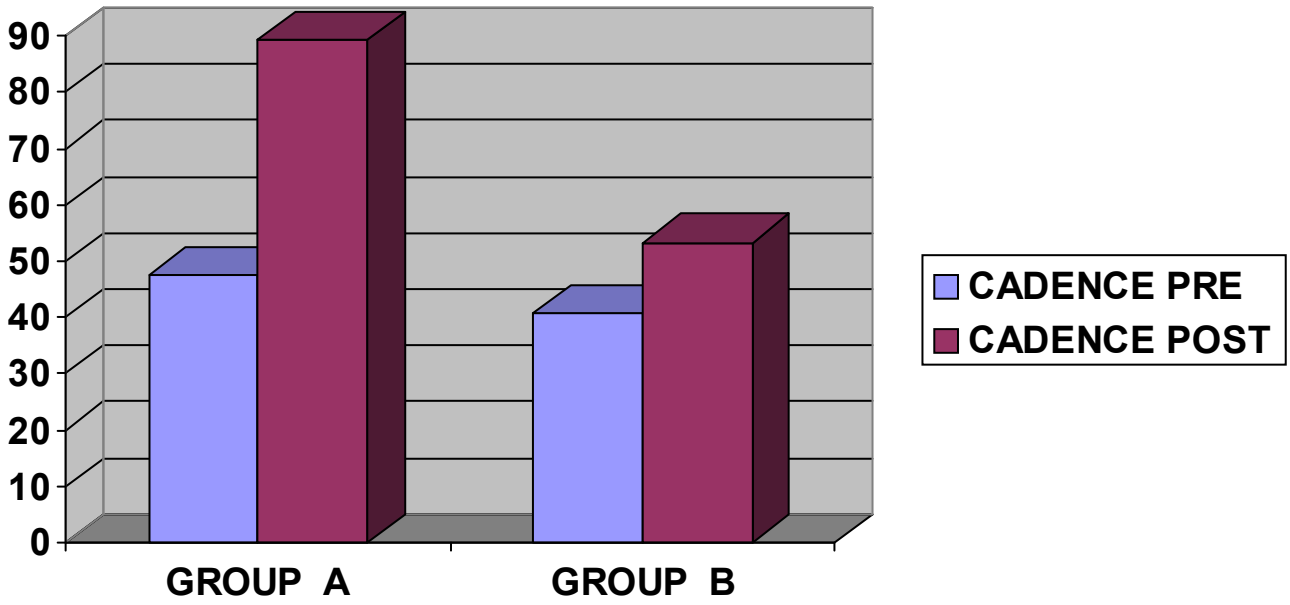
GRAPH 1:FUNCTIONAL AMBULATION PROFILE OF GROUP A & B



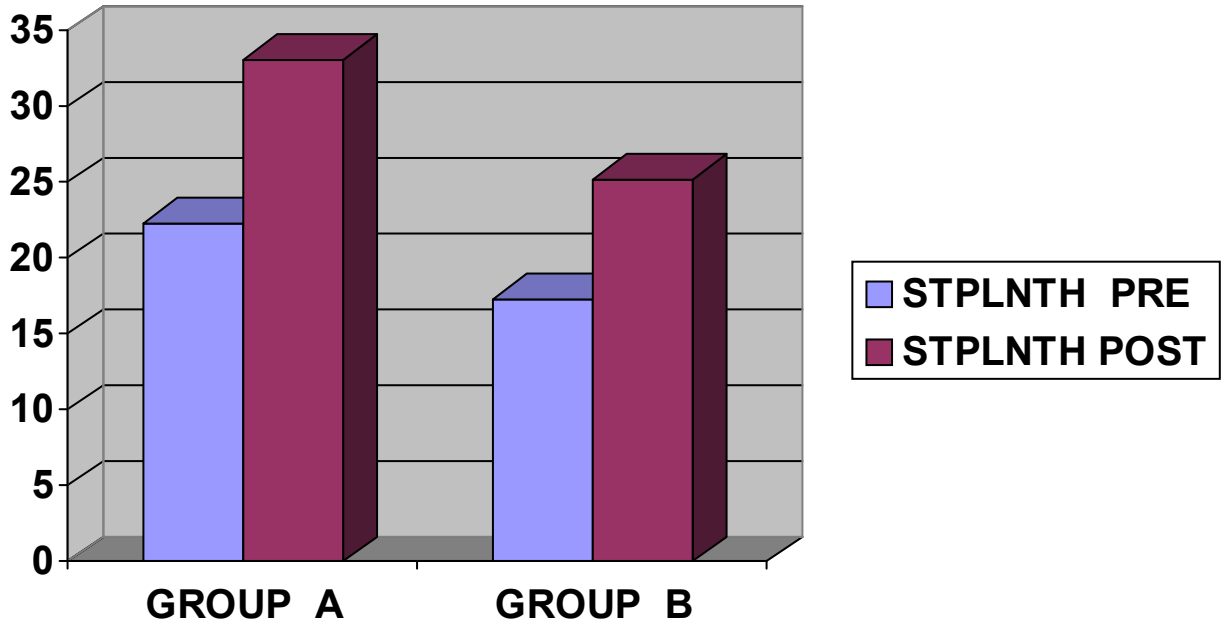
GRAPH 2: VELOCITY OF GROUP A & B



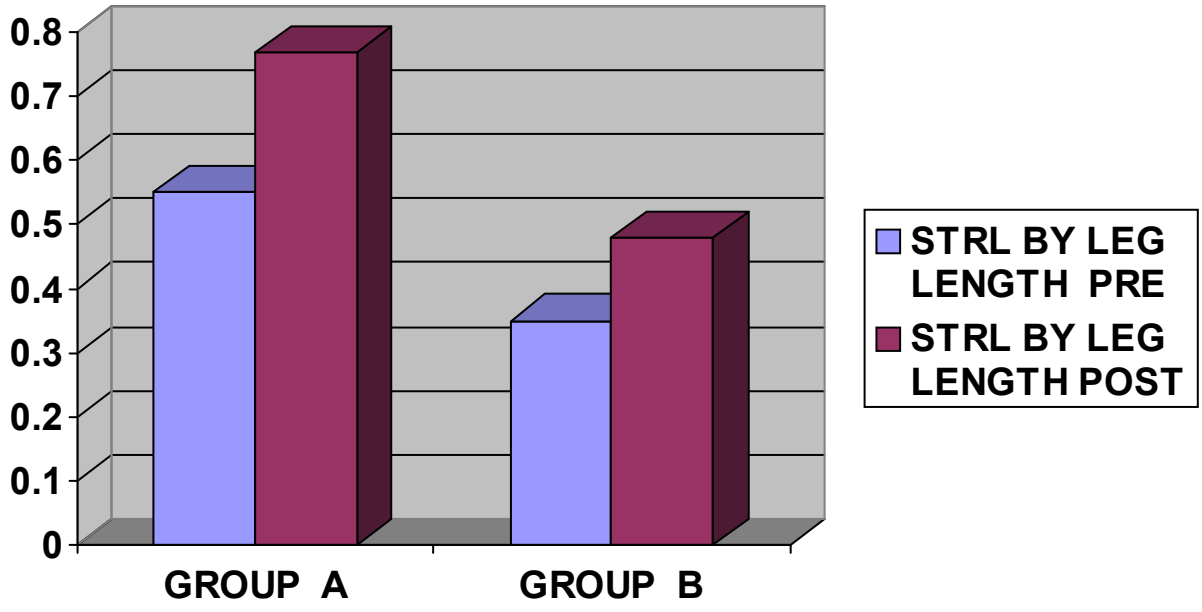
GRAPH 3: CADENCE OF GROUP A & B



GRAPH 4: STEP LENGTH OF GROUP A & B



GRAPH 5: STRIDE LENGTH OF GROUP A &B



Discussion

The results of this study revealed that kinematic chain exercises shows a significant improvement in sub acute stroke patients, though there were favorable and significant differences between the effects of open kinematic chain and closed kinematic chain exercises. Results show that CKC proved to be more beneficial in improving gait performance as compared to OKCE.

OKC exercises can isolate a specific muscle group for intense strengthening and endurance exercise, thus allowing more isolated muscle activation because such a limited amount of muscular co.contractionis inherent in these exercise movements in addition they can develop strength in very weak muscles that may not function properly in CKC systems because of muscle substitution. OKC exercise may produce great gains in peak force production and are usually limited to one joint in a single plane (uniplanar).

OKC are characterized by a rotatory stress pattern at the joint. These exercises are non-weight bearing exercises (19).

CKC activities be used to restrain joints and muscle proprioceptors to respond to sensory input .CKC exercises provides greater joint compressive forces. In CKCE, multiple joints are exercised through weight bearing and muscular contraction; velocity and torque are more controlled, shear forces are reduced, joint congruity is enhanced; proprioceptors are re-educated; postural and dynamic stabilization mechanics are facilitated and exercise can work in spiral or diagonal movement patterns (19).

CKC stimulates proprioceptors, increase joint stability, increases co. activation, allow better utilization of the said(specific adaptations to imposed demand) principle and permit more functional patterns of movement particularly in lower extremity because they closely stimulate the actual movement patterns encountered in daily activities (19).

In cases where stroke is accompanying other degenerative conditions (e.g. O.A) thus restricting weight bearing, it may prevent certain CKC exercises from being used, here OKC exercises are not limited because of their non- weight bearing nature.

Closed chain motion alters the nature of muscle contractions as well as bone motion. During dorsiflexion of ankle joint; in open chain dorsiflexion, the dorsum of

the foot moves up towards the lower leg while in closed chain dorsiflexion of the ankle(for e.g. during gait) occurs when the tibia moves forward while the foot remains stationary on the ground. This motion is not produced by contraction of the dorsiflexor muscles. Rather, the dorsiflexion results from forward movement of the lower leg over the foot. The muscles that produce plantar flexion (the calf group) are active during closed chain dorsiflexion to eccentrically control this motion. Thus the problem of foot drop in stroke patients can be overcomed (40).

Obligatory internal rotation of the lower leg occurs whenever subtalar joint goes into pronation and external rotation occurs with supination.

These rotations are important along with hip and knee motion during gait. Motion of the subtalar joint creates a dynamic change in arch height. During chain pronation arch height decreases as while with supination height relatively increases. Closed chain pronation not only lowers the arch but also lowers the pelvis by creating a functional decrease in leg length. Any change in subtalar joint motion leads to asymmetric motion of the pelvis (40).

CKC exercises like squatting, step-up and down, bicycling concentrates on co. contraction of the quadriceps, hamstrings, hip flexors, soleus and gastrocnemius muscles. Also since this is a multijoint movement, it focuses on the knee, hip and ankle (36,41).

Squat strength requires muscle recruitment for hip and knee joint performance. Several studies have shown that strength training improves balance. However, improved balance scores have been reported after improved hip, knee and ankle strength. Clinically, muscle weakness has been recognized by patients and therapists as a limiting factor in the gait rehabilitation of patients after a stroke. Many studies revealed that a program of muscle strengthening proved beneficial for improving

the gait performance of stroke subjects. Significant improvement in strength, balance and functionality as a result of both OKC and CKC program was found.

The appropriately planned rehabilitation program on the basis of the results can allow a patient to achieve better recovery in gait performance.

Future Research

This study has established that OKC and CKC have improvement in gait performance in sub acute patients and comparison been done between the effects of these revealing better improvement in CKCE group.

Future research is needed to identify the effect of more intense OKC and CKC exercises on stroke patients in all the stages of recovery. The effects of OKC and CKC exercises on lower extremity function and trunk balance in stroke patients need to be elucidated.

Conducting related studies in different neurological patients such as paraplegia, CP, head injury and other disorders can carry this study forward.

Relevance in Clinical Practice

The findings of this study revealed that CKC and OKC demonstrated good subjective and overall functional outcomes, thus indicating significant relevance to clinical practice.

CKC and OKC exercises in regular therapeutic program in gait rehabilitation would constitute an advantageous and effective adjunct in improving hemiplegics gait in sub acute stroke patients.

This study establishes that CKC exercises have a better improvement in gait performance in sub acute stroke patients thus, this study give a greater clinical confidence in deciding effective protocol for stroke patients.

Conclusion

Judicious thought should be given in choosing exercise for rehabilitation program. Decision should be made relative to which exercise best meet the intended goals of the rehabilitation or conditioning program.

This study found that statistically significant improvement on the gait performance in sub acute stroke patients by CKC and OKC have occurred. Along with this we can also conclude that CKCE have better improvement as compared to OKCE.

Thus the hypothesis that there will be differences in the effect of OKC and CKC exercises in improving gait performance in sub acute stroke patients holds true.

Limitations of the Study

1) Sample size is small. (30 patients were included).
2) Duration of the study is small (5 weeks).
3) ACA, PCA stroke patients were not included.
4) Chronic stroke patients were not included in the study.

Consequently it is difficult to generalize the results to all / other stroke patients

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Test-Retest Reliability for Test of Visual Perceptual Skills (Non-motor)-Revised in Normal Children (Age 4-12 Years)

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Abstract

Objective: To assess test- retest reliability for Test of Visual- Perceptual Skills (non-motor) - Revised (TVPS-R) in normal children (Age 4 to 12 years).

Study Design

Cross sectional

Methodology

240 children between age groups 4 to 12 years attending normal school were recruited for the study. TVPS-R was administered twice with a gap of one week duration to find test retest reliability

Results

The intraclass coefficient correlation for the total test ranged from 0.83 to 0.97 indicating good test retest reliability. The intraclass coefficient correlation for each subtest ranged from 0.21 to 0.97 indicating very poor to good test retest reliability. In the results of individual subtests, variations were found most commonly in the subtests of visual memory and visual sequential memory. In visual memory, 5 age groups (5-6, 7-8, 9-10, 10-11, and 11-12) and visual sequential memory, 5 age groups (4-5, 7-8, 9-10, 10-11, and 11-12) showed poor to moderate intraclass coefficient correlation ranged from 0.21 to 0.65.

Conclusions

Total test scores of TVPS-R shows good test-retest reliability. Test-retest reliability of individual subtests shows variations. Thus in clinical decision making or treatment planning, TVPS-R total test scores should be considered, rather than the individual subtest scores.

Key Words

visual perception, motor problems, reliability

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Introduction

Perception refers to integration of sensory impression into psychologically meaningful information. [1] The development of visual perception begins at birth with the reception of visual stimuli, followed by orientation of the head and eyes and the identification and integration of dominant visual cues. [2]

The child's first perceptions of his world develop primarily from tactile, kinesthetic, and vestibular input. Vision and auditory input is later matched against the other senses and integrated in to the child's perception of his world. Because visual perception is believed to be the end product of normal sensory integration, many motor control issues with a visual motor and visual-perceptual basis are considered as dysfunctions with in the realm of sensory integration. Visual perception has a direct impact on eye hand coordination, eye-hand and eye foot dissociation.[3]

In the developing child, there is a systematic increase in the ability to perceptually analyze and discriminate objects. Visual perception contributes to the performance of school related tasks such as copying, reading, spelling, and art skill. Visual perception is used to validate other sensory and motor information coming into the system and sub serves motor coordination and performance. A child who has sensory processing problems will have problems in visual perception and will appear disorganized and

scattered in his motor function. [3] For a visual perception deficit to be identified the primary senses such as visual acuity must be intact. [1]

Children with motor problems have frequently been identified as a group with visual perceptual problems. Visuospatial and perceptual deficits may impair gross motor performance and functional independence in a child. A figure ground deficit or the inability to distinguish a given form from the background may make a change in terrain depth during gait training. [4]

It has long been recognized that severe disturbances in visual perception can interfere with activities of daily living.[5] It is important to consider assessment of visual perception in the children with motor problems. Visual stimulation is one of the therapeutic measures given to these children. To find the effectiveness of any therapy, outcome measures are important. Test of visual perceptual skills (Non –motor) Revised (TVPS-R) is one of the outcome measures to assess the visual perception.

Gardiner [6] designed the motor free test of visual perceptual skills (Non –motor) Revised (TVPS-R) to assess the visual perception in 4 to 12 years old children. The TVPS-R involves the use of predawn configurations and design there by excluding any motor component in the administration. The TVPS-R assesses visual perceptual strengths and weakness in children 4 to12 years. The test consists of 112 items grouped in 7 subtests (i.e. visual discrimination, visual memory, visual spatial relationships, visual form constancy, visual sequential memory, visual figure ground, visual closure).

When selecting a test for use with children in clinical practice or in research, professionals need to consider the reliability and validity of the test. [7,8] One essential type of reliability is test retest reliability. It is an index of score stability overtime that allows therapist to be confident that score changes reflect change in the subject performance rather than random error. Test retest reliability of TVPS-R was not reported in the manual, Chan et al [9] studied Test retest reliability of TVPS-R for 4-5 years of age, but it is used for 4-12 years of age, so there was a need for Test retest reliability of TVPS-R for 4-12 years of age.

Methodology

Subjects

Children between age groups 4 to 12 years attending normal school were recruited into the study. 30 children from each age group, aged between 4-12 years and a total of 240 children were assessed. The demographic data of the children is given in Table1.

Table-1: Demographic Data

AGE	N	BOYS	GIRLS	MEAN AGE(MONTHS)	S.D OF AGE
4-5 YEARS	30	14	16	54.33	2.45
5-6	30	18	12	66.60	2.56
6-7	30	14	16	77.66	3.41
7-8	30	15	15	85.93	2.44
8-9	30	15	15	101.00	2.61
9-10	30	15	15	113.43	2.34
10-11	30	15	15	126.80	2.46
11-12	30	15	15	138.26	2.59
TOTAL	240	121	119	54.33	2.45

Inclusion Criteria

Children attending to normal school (Age 4 to 12 years)

Exclusion Criteria

1. Children diagnosed with physical, intellectual or sensory impairments.
2. Children with special educational needs.
3. Uncooperative children

Instruments

- Test of Visual Perceptual Skills Manual, testing plates, and record forms.
- Two chairs
- Table
- Stop watch
- Isolated room

Procedure

The study was conducted during the period of April 2006 and January 2008. Approval was taken from scientific committee and Instituitional Ethical Committee. The list of schools in Mangalore and consent for carrying out the study was obtained from Block Education Officer, Mangalore. From a list of 119 schools, 3 schools were selected randomly by lottery method for conducting the study. Out of the 3 schools, one school refused to give consent for the study, subsequently, one more school was selected from the remaining schools by lottery method.

Based on sample size calculation, a sample size of 240 was obtained. In the present study, the children were divided into 8 subgroups (4-5 years, 5-6 years, 6-7 years, 7-8 years, 8-9 years, 9-10 years, 10-11 years, and 11-12 years). Under each subgroup there were 30 children. Therefore 10 children were selected in each age group from each of the 3 schools. Informed consent was taken from the Principal and concerned class teacher of each school. Each child was taken to a calm, distraction free room. The test procedure was explained and test was administered individually for each child according to the instructions given in the manual. Figure 1 shows tests plates and Figure 2 shows the test being performed on a child. Each subtest consists of simple

Figure 1: TVPS-R test plates

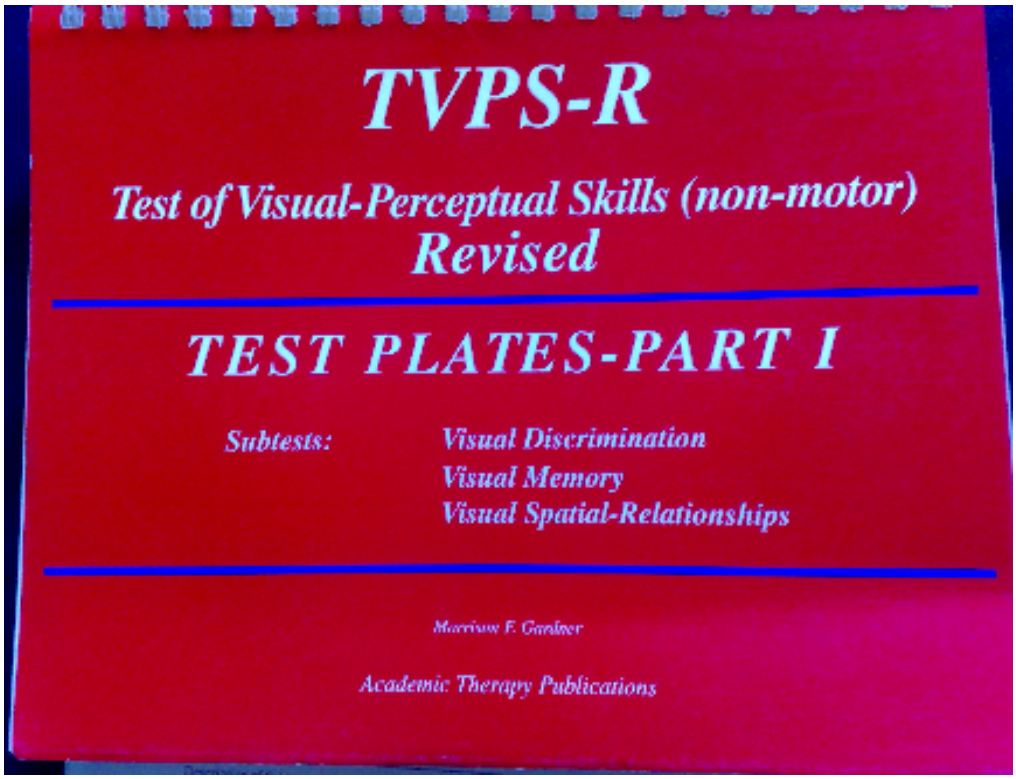


Figure 2: Testing of Visual perception on an 8 year old girl using TVPS-R

Verbal instructions of either one or two sentences e.g. - look at this form and remember it so that you find it on another page. Find it among these forms. In all the subtests children were required to indicate the correct answer out of either 5 choices by any means (e.g. by pointing or verbal indication). Each subtest ends when the child makes 3 errors on 4 consecutive items on a subtest with 4 choices or 4 failures on 5 consecutive items on a subtest with 5 choices.

The test was stopped when the child attained ceiling and preceded with the next subtests. The same procedure was repeated after one week in the same environment. All the children were made to undergo the test procedure in the same way.

Data Analysis

The statistical analysis was done using the SPSS 11.0 software package. The test and retest total scores and subtest scores of TVPS-R was estimated by intraclass coefficient correlation (ICC) by using Pearson product moment correlation formula.

Results

A total of 240 children participated in the study. The ICC of the test- retest reliability for the total test ranged from 0.83 to 0.97 indicating good test retest reliability (Table 2).The ICC for each subtest ranged from 0.21 to 0.97 (Table 2) indicating very poor to good test retest reliability.

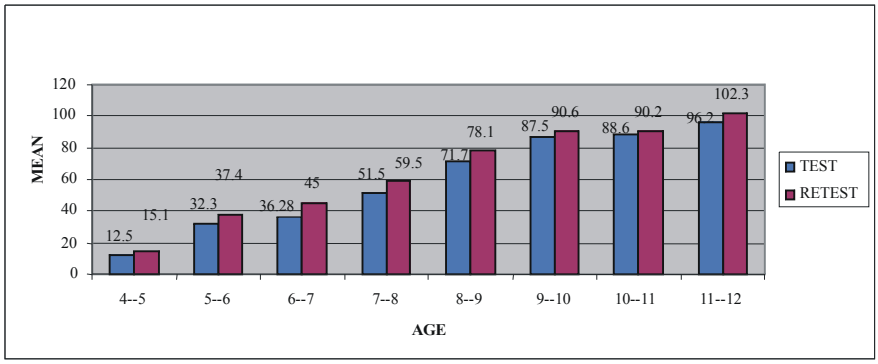
In the results of individual subtests, variations were found most commonly in the subtest of visual memory and visual sequential memory. In visual memory, 5 age groups (5-6,7-8,9-10,10-11,and 11-12) showed poor to moderate ICC. (Table 2). In visual sequential memory, 5 age groups (4-5, 7-8, 9-10, 10-11, and 11-12) showed poor to moderate ICC. (Table 2)

Table - 2: ICC values 0f TVPS-R (4 – 12 years)

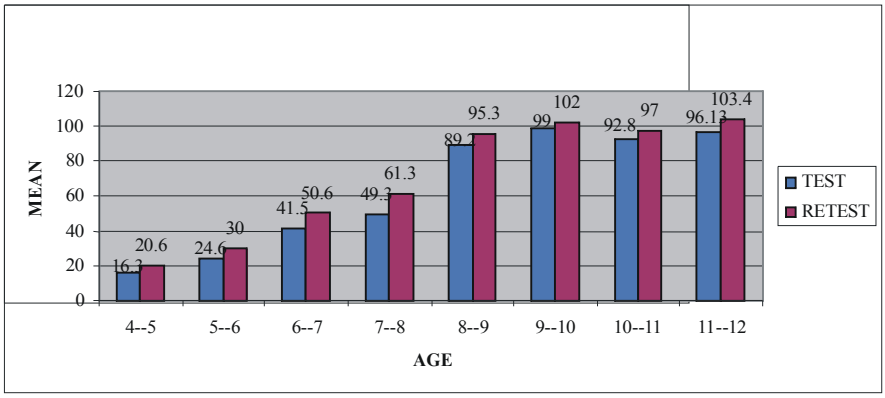
Age (Years)		4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
VD	r - value	0.873	0.649	0.521	0.33	0.466	0.786	0.802	0.682
	ICC	0.932194	0.787144	0.685076	0.496241	0.635744	0.880179	0.890122	0.810939
VM	r - value	0.945	0.359	0.565	0.492	0.636	0.297	0.391	0.301
	ICC	0.971722	0.52833	0.722045	0.659517	0.777506	0.45798	0.562185	0.462721
VSR	r - value	0.488	0.727	0.742	0.728	0.888	0.468	0.621	0.422
	ICC	0.655914	0.841922	0.851894	0.842593	0.940678	0.637602	0.766194	0.59353
VFC	r - value	0.848	0.398	0.304	0.76	0.692	0.398	0.542	0.717
	ICC	0.917749	0.569385	0.466258	0.863636	0.817967	0.569385	0.702983	0.835178
VSM	r - value	0.376	0.833	0.761	0.162	0.587	0.119	0.227	0.469
	ICC	0.546512	0.908893	0.864282	0.27883	0.739761	0.21269	0.370008	0.63853
VFG	r - value	0.872	0.735	0.605	0.599	0.344	0.526	0.517	0.372
	ICC	0.931624	0.847262	0.753894	0.749218	0.511905	0.689384	0.681608	0.542274
VC	r - value	0.714	0.666	0.551	0.65	0.826	0.695	0.727	0.263
	ICC	0.833139	0.79952	0.710509	0.787879	0.90471	0.820059	0.841922	0.416469
Total	r - value	0.948	0.886	0.821	0.885	0.84	0.712	0.81	0.878
	ICC	0.973306	0.939555	0.901702	0.938992	0.913043	0.831776	0.895028	0.935037

VD -Visual discrimination
VM -Visual memory
VSR -Visual spatial relationships
VFC -Visual Form Constancy
VSM-Visual sequential memory
VFG -Visual figure ground
VC -Visual closure

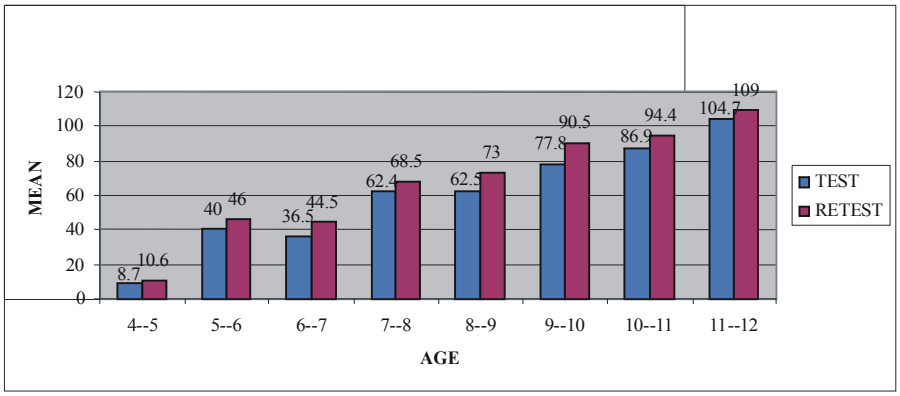
Graph - 1; TVPS-R total mean scores of test and re-test for children 4-12 years



Graph - 2; TVPS-R total mean scores for Boys (4-12 years)



Graph – 3; TVPS-R total mean scores for Girls (4-12 years)



It can be observed in graphs that the re-test scores were high irrespective of age group, but this increase in mean values have not shown any significant statistical difference, thus indicating a good test-re test reliability. It also shows that as age increases the total mean scores also increases (graph 1, 2 and 3).

Discussion

In the present study total test scores showed good test-retest reliability for 4-12 years of age, ICC ranging from 0.83 to 0.97, similar to the findings reported by McFall et al [10] and Chan et al. [9] But the individual subtest scores showed poor to good reliability, ICC ranging from 0.21 to 0.97.

Our results also showed that there was a slight Improvement shown in retest values in all the age groups, the reason may be due to the fact that children became familiar with the test plates, environment and the tester. We also

observed that during retest, the speed of performance improved.

Out of 7 subtests only visual memory and visual sequential memory showed poor to moderate reliability in 5 age groups, whereas the other 5 subtests showed good to moderate reliability in more than 7 age groups. The reasons could be that the children needed to match one form from a set of given forms on the same test plate, thus giving the child an opportunity to constantly compare the form to be matched or discriminated from other forms on the same test plate.

In our study visual memory and visual sequential memory showed poor to moderate reliability. These subtests involved the child to memorize one form and also the child has to recall the same form in the subsequent test plate, unlike the other subtests where there was no need of recalling the test forms. As the test plates progressed, difficulty in the test plates increased resulting in greater difference in the test and retest values for these subtests. Memory recall and motivation could be one of the factors which led the child to perform better in the retest or to reach the ceiling effect much earlier in the retest.

Our results also showed that TVPS-R is free from gender bias and supports the use of this test for children of both genders without the need for separate items or norms, for different genders similar to results reported by Chan et al. [8]

It was also observed that children of 4-6 years of age reached ceiling effect faster. Probably it was due to less ability to concentrate on one activity. As the age increased they were able to concentrate and perform the tests for longer period of time.

In our study it was observed that, as the age increases from 4 to 12 years, there is a gradual increase in total scores of TVPS-R, indicating that visual perception improves with age. From 8 years onwards there is a steep increase in total scores of TVPS-R as shown in Graph 1.The above results shows that when TVPS-R is used for decision making or treatment planning, the total test scores should be considered and not the subtest scores.

Future Suggestions

- The test-retest reliability of TVPS-R can be done on children with various motor disabilities.
- TVPS–R can be used as one of the outcome measures to evaluate intervention programs for visual-perceptual problems.

Conclusion

- Total test scores of TVPS-R shows good test-retest reliability
- Test-retest reliability of individual subtests shows variations. Thus in clinical decision making or treatment planning, TVPS-R total test scores should be considered, rather than the individual subtest scores.
- Therapists can have a good confidence in data collection and they can draw rationale conclusions from the total test scores of TVPS-R

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Clinical Significance of Electrodiagnosis in L_5 - S_1 DISC Herniation

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Abstract

This was an experimental and comparative study done to see the effect of L5 – S1 disc herniation on MNCV, its latency difference and H reflex latency and to prove the efficacy of electrodiagnosis as a reliable tool to assess the S1 radiculopathy due to disc herniation. MNCV, its latency difference and H reflex latency was compared between affected and unaffected sides of 12 symptomatic and MRI diagnosed subjects. Affected side data was also compared with normative data. CONCLUSION: MNCV and H latency showed significant changes between affected and unaffected sides but M latency presented insignificant results. Comparison of data with normative data also showed significant changes, thus proving electrodiagnosis as a reliable adjunct to MRI.

Key Words

MRI, Electrodiagnosis, MNCV, H-reflex, S_1 Radiculopathy

Introduction

Backache is a national, personal and clinical problem because it is experienced by most of the populations at some time and is a drain on the nation's resources, personal because it can remain a major unsolved dilemma, but methods of treatment are conflicting and often unrewarding(A VAISHNAVI). There are many causes of low back pain (LBA) and it is mainly related to the disc pathologies. As a result of wear and tear on the spine, ligaments, and disks, a disk may begin to protrude or collapse and put pressure on the nerve root leading to a leg or foot, causing pain in those areas (sciatica).The problem can be aggravated by associated conditions, such as lumbar canal stenosis, spondylolisthesis. Low back pain is sometimes caused by excessive stress to the back, such as lifting something heavy; Minimal movement, such as bending or reaching for something; Arthritis of the spine; Problems with tendons or ligaments in and around the spine; Malpositioning of vertebrae (Giuliano V)'

Lumbar disc herniation occurs 15 times more often than cervical disc herniation, and it is one of the most common causes of lower back pain. The cervical discs are affected 8% of the time and the thoracic discs only 1 - 2% of the time (V). Most disc herniations occur when a person is in their thirties or forties when the nucleus pulposus is still a gelatin-like substance. With age the nucleus pulposus changes ("dries out") and the risk of herniation is greatly reduced. After age 50 or 60, osteoarthritis degeneration or spinal stenosis are more likely causes of low back pain or leg pain.

Symptoms of disc herniation may include dull or sharp pain, muscle spasm or cramping, sciatica, and leg weakness or loss of leg function. Sneezing, coughing, or bending usually intensifies the pain. Rarely bowel or bladder control is lost. Sciatica is a symptom frequently associated with a lumbar herniated disc. Pressure on one or several nerves can cause pain, burning, tingling, and numbness that extends from the buttock into the leg and sometimes into the foot. Usually one side (left or right) is affected.

Lumbar disc herniations occur most often between the fourth (L_4) and fifth (L_5) lumbar vertebral bodies or between the L5 and the sacrum (S_1) (R. Prasad,).

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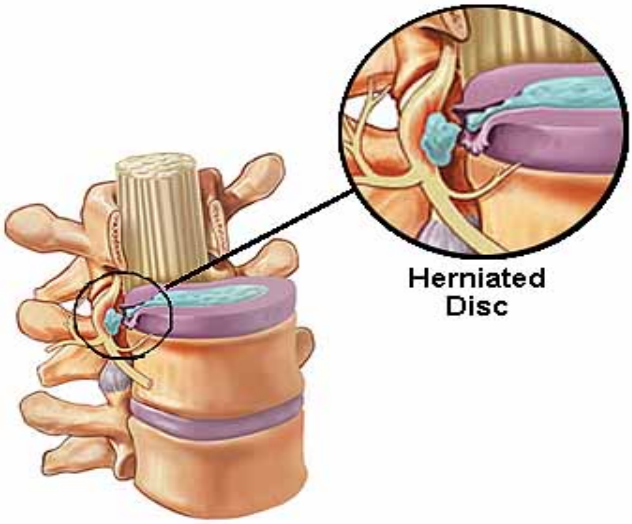


To diagnose PIVD, the most commonly used diagnostic tool is Magnetic Resonance Imaging. The development of large bore homogeneous magnets and computer assisted imaging extended its use into mapping of hydrogen nuclei densities and their effect on surrounding molecules in vivo. Since these vary from tissue to tissue MRI can provide detailed image of whole body. Now the studies have proved that MRI is not reliable as it gives false positive findings in asymptomatic patients also.

Now where imaging studies and clinical assessment do not coincide, electrodiagnosis can provide reliable information. Imaging studies visualize the structural abnormalities from which the neurological sequlae may be inferred, whereas the electro diagnostic methods such as nerve conduction studies and electromyography assess the physiological integrity of the nerve root and have the added benefit of sensitivity to the non structural root disease.[35]

This study attempts to find out the efficacy of electro diagnostic studies (MNCV and their latency differences and H- reflex latency) in the diagnosis of S1 radiculopathy due to L5- S1 disc herniation and to prove it as a reliable adjunct to MRI.

Methodology

Population

143 subjects of either sex, aged between 20 – 50 years were selected on the basis of inclusion and exclusion criteria.

Source

Subjects were taken from the following centres:

- Department of Physiotherapy,Punjabi University, Punjab.
- Department of Physiotherapy, SBSPGI, Dehradun

Sample

Twelve (12) subjects were selected for the study on the basis of inclusion and exclusion criteria.

Procedure

1. Recording MNCV:

Before beginning with the procedure, the subjects who were selected on the basis of inclusion criteria were explained the entire procedure in detail and their consent was taken. They were then assessed according to the assessment chart. The subject were made to lie down in prone position comfortably on a plinth. Metallic ornaments on the limb were removed. The lower limbs were exposed from mid thigh to the foot. The resistance of the skin of leg was reduced using cotton dipped in alcohol. The recording electrodes were placed in the foot with the cathode placed over the belly of abductor hallucis brevis muscle and the anode on the belly tendon montage. The ground electrode was strapped to the mid calf. First, the supramaximal stimulus was given to the tibial nerve distally posterior to the medial malleolus . The wave and distal latency were recorded. The second supramaximal stimulus was given proximally

at the popliteal fossa medial to the mid line at the popliteal crease. The distance between the proximal and the distal stimulating sites was measured using a flexible measuring tape. The wave and latency were recorded bilaterally. The MNCV was then calculated as follows:

$$MNCV = \frac{D \text{ (meters)}}{PL - DL \text{ (seconds)}}$$

Where,

D= distance

PL= proximal latency

DL= distal latency

2. Recording H- reflex:

For recording H- reflex the cathode electrode was placed over the mucle tendon junction and the anode was placed over the tendon of the gastrosoleus muscle. Ground electrode was strapped to the mid calf region. Submaximal stimulus was given at popliteal fossa lateral to the midline and wave and latency were recorded bilaterally.

The data obtained from affected and unaffected sides were compared and analysed. MNCV and H-reflex latency of affected side were also compared with the normative data from previous literature (values of normative data of MNCV and H reflex latency is 54.002 ± 2.7 and 27.3 ± 1.5 respectively).

Data Analysis and Results

The data was analyzed by using the Software SPSS version 11.0. The paired t test has been done for comparing the affected and unaffected H-latency and MNCV values. The unpaired t test has been done for comparing the H-latency and MNCV values of affected side and normative data provided in previous study. Significance level has been selected as 0.05.

TABLE 1: Mean and S.D. of the Age of Subjects of This Study and Subjects of Normative Data

VARIABLE	MEAN	S.D.
SUBJECTS OF THIS STUDY AGE	37.833	8.177
SUBJECTS OF NORMATIVE DATA AGE	23.96	2.398

The table 1 shows values of mean and S.D. of age of the subjects of this study and the normative data. The values of mean ± S.D. are 37.833±8.177 and 23.96±2.398 respectively.

TABLE 2: Mean and S.D. Values of H Latency of Affected and Unaffected Side

VARIABLES	AFFECTED	UNAFFECTED	DIFFERENCE
MEAN	33.7000	32.9143	.7857
S.D	2.93712	3.22461	.59841

The table 2. shows mean and S.D. values of H- latency of affected and unaffected side. The values of means ± S.D. of H –latency of affected and unaffected side are 33.700± 2.93712 and 32.9143 ± 3.22461 respectively

TABLE 3:Mean and S.D. Values of MNCV Affected and Unaffected Side

VARIABLES	AFFECTED	UNAFFECTED	DIFFERENCE
MEAN	46.8475	50.3942	-3.5467
S.D	3.56392	7.21837	5.32523

The table 3 shows mean and S.D. values of MNCV of affected and unaffected side.

The values of means ± S.D. of MNCV of affected and unaffected side are 46.8475± 3.56392 and 50.3942 ± 7.21837 respectively.

TABLE 4: Comparison Between Values of H-Latency and MNCV Affected and Unaffected side (Paired t-Test)

VARIABLES	t VALUE	P VALUE	SIGNIFICANCE
H-LATENCY	3.474	.013	S
MNCV	-2.307	.042	S

Table 4 shows comparison between affected and unaffected values of H-latency and MNCV. Paired t- test applied between the values of affected and unaffected sides. The t value for H-latency is 3.474 and p-value is .013, which is significant. The t- value for MNCV is 2.307 and p- value is .042, which is significant.

TABLE 5: Mean and S.D. Values of H-Latency of affected and Normative Data

VARIABLES	AFFECTED	NORMAL
MEAN	33.70000	27.3
S.D	2.93712	1.5

The table 5 shows mean and S.D. values of H-latency of affected and normative data. The values of means ± S.D. of H-latency of affected and normative data are 33.700±2.93712 and 27.3 ± 1.5 respectively. .

TABLE 6: Mean and S.D. Values of MNCV of Affected and Normative Data

VARIABLES	AFFECTED	NORMAL
MEAN	46.8475	54.002
S.D	3.56392	2.7

The table 6 shows mean and S.D. values of MNCV of affected and normative data

The values of means ± S.D. of MNCV of affected and normative data are 46.8475± 3.56392 and 54.002 ± 2.7 respectively.

TABLE 7: Comparison Between Values of H-Latency and MNCV Affected and Normal Side (Unpaired t-Test)

VARIABLES	t VALUE	p VALUE	SIGNIFICANCE
H-LATENCY	8.994	< 0.05	S
MNCV	7.840	< 0.05	S

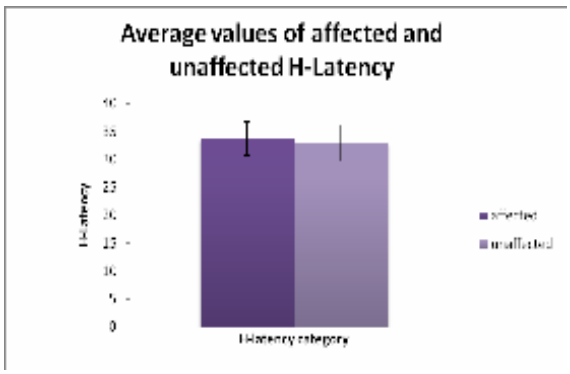
Table 7 shows comparison between affected and normative data of H-latency and MNCV. Unpaired t- test applied between the values of affected and normative data. The t value for H-latency is 8.994 and p-value is < 0.05, which is significant. The t- value for MNCV is 7.840 and p- value is < 0.05, which is significant.

TABLE 8: Mean and S.D. Values of Motor Nerve Latency of Affected and Unaffected Side

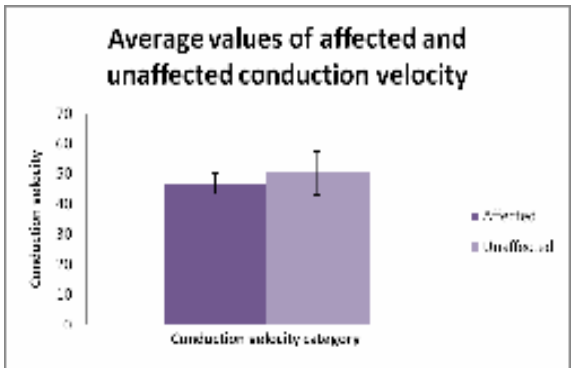
VARIABLE	MEAN	S.D.
AFFECTED	3.8775	1.117
UNAFFECTED	3.4808	1.317

The table 8 shows mean and S.D. values of Motor Nerve Latency of affected and unaffected sides. The values of means ± S.D. of MNCV of affected and normative data are 3.8775± 1.117 and 3.4808 ± 1.317 respectively.

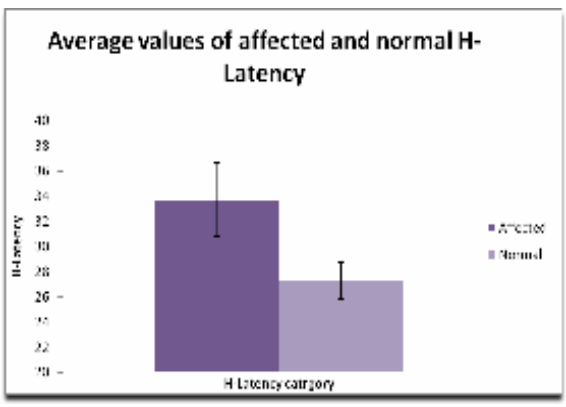
GRAPH 1



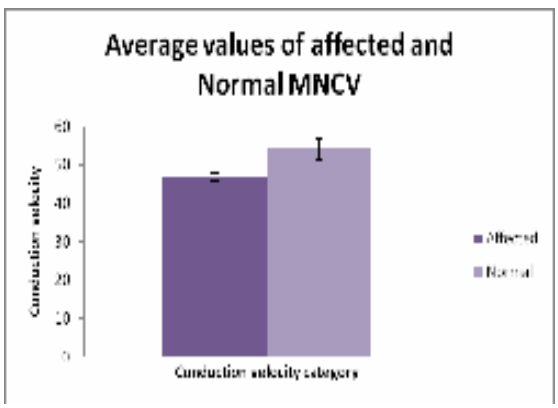
GRAPH 2



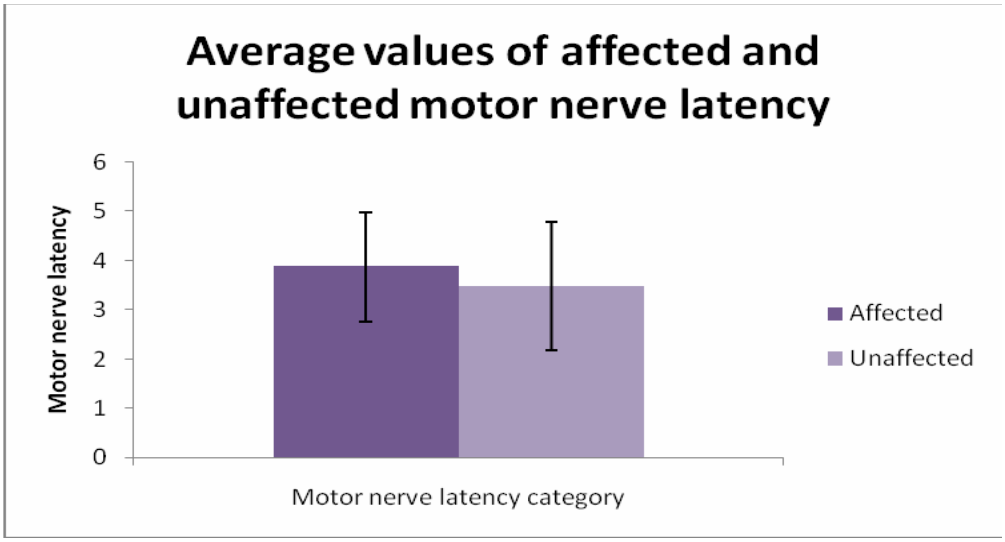
GRAPH 3



GRAPH 4



GRAPH 5



Discussion

This was an experimental study done to see the effect of L5-S1 disc herniation on H reflex latency, MNCV and their latency differences. Nerve root involvement due to disc herniation is characterised by clinical abnormalities and confirmed by radiological examination. MRI is a clinically superior diagnostic test in evaluation of patient with suspected lumbar disc herniation. Imaging studies visualize structural abnormalities, however they are associated with high false positive results as stated by (Masui et al (2005), Giuliano et al (2004)). To avoid any inaccuracy in diagnosing nerve root compression, electrodiagnostic studies must be incorporated. One form of electro diagnostic testing is Nerve Conduction Studies. NCV is widely used for evaluation of musculoskeletal and neuromuscular complaints. Although similar clinical value is expected for the evaluation of nerve root compression, prior application of NCV studies yielded widely varying results.

In this study 12 subjects with MRI confirmed disc prolapse at L5 – S1 level were taken. The subjects had at least one of the following findings on clinical examination: positive straight leg raise test, diminished or absent ankle jerk, sensory loss in S1 dermatome. The posterior tibial nerve was evaluated bilaterally in all the subjects using standard nerve conduction procedures, which consisted of measurement of motor nerve conduction velocity, latency differences and H reflex latency.

Paired t test was used to analyse the readings obtained from affected and unaffected sides. The MNCV for posterior tibial nerve was found to be significantly lowered in the affected side ($p < 0.042$) but changes in the latency difference were found to be non significant ($p > 0.05$). The result supports the study of Ogura T (2003), Shikata H. They stated that the CMAP amplitude was significantly lower in the patients with lumbar disc herniation, and the latency was also prolonged when the stimulating electrode was placed above the lesion. This technique may thus be a useful non-invasive method for assessing lumbosacral nerve root function in patients with lumbar disc herniation.

The H latency on the affected side was significantly prolonged on affected side in seven patients ($p < 0.013$)as also shown by Han TR et al (1997) and Bobinac – Geogogevski et al (1991). The H reflex was absent in four patients bilaterally and unilaterally on affected side in one patient which gives 41% absent H reflex data.

The probable reason for the above observations may be that the lumbar disc herniation causes two types of effects on nerve roots that is chemical and mechanical. Presence of disc material in the epidural space is thought to initially result in direct toxic injury to the nerve root by biochemical means which will cause intraneural oedema within 2 hours and that will lead to a reduction of intraneural blood

flow within 3 hours. Histological changes of nerve roots are present after 3 hours and subsequent reduction of nerve conduction velocity will start between 3 to 24 hours after disc protrusion (Robert Gunzburg). The contact pressure exerted by lumbar disc herniation on the nerve roots was recorded to be 53 mm Hg which produces mechanical deformation and causes conduction block (Takahashi K)

When the H-reflex latency and MNCV of affected side was compared with normative data obtained from previous studies (the values of MNCV and H reflex latency is 54.002 ± 2.7 and 27.3 ± 1.5), the results were highly significant with p value = 0.000 and 0.000 respectively.

The data of this study supports the concept that there are significant changes in MNCV and H reflex latency in unilateral S1 radiculopathy supporting the alternate hypothesis and rejecting the null hypothesis. The use of NCV studies for this application has several advantages like H- reflex component of NCS directly examines the electrophysiological function of S1 root, secondly, the non invasive and wide availability of nerve conduction measurement may facilitate their clinical use in assessment of possible nerve root compression. After all the analysis and comparison with previous studies we can say that this study will help in the diagnosis of S1 nerve root compression.

Conclusion

The MNCV of affected side was markedly reduced and H latency was prolonged, which are suggestive of diagnosis of S1 radiculopathy. In the results obtained, latency differences were found to be non significant so latency difference cannot be taken as reliable tool in diagnosing S1 radiculopathy. This study thus proves that MNCV and H reflex can be used as reliable diagnostic tool for S1 radiculopathy. When the significance level of H- reflex latency and MNCV were compared, the H- reflex latency was found to be more reliable tool in the diagnosis of S1 radiculopathy.

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Indian Journal of Aeronautical Dentistry	***4***	***2000***	***200***
Indian Journal of Dental Education	***4***	***2000***	***200***
Indian Journal of Emergency Pediatrics	***4***	***4000***	***200***
Indian Journal of Forensic Medicine & Pathology	***4***	***8000***	***200***
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Effect of Different Positioning of COntralateral Arm on Upper Limb Neurodynamic Test (1).

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Abstract

Purpose

To see the effect of different positioning of contralateral arm on neurodynamic test for the upper limb.

Design

Experimental study on healthy subjects.

Methodology

Upper Limb Neural Test 1 was performed by placing the contralateral arm in Neutral, Horizontal Abduction, Horizontal Adduction and Flexion positions. Range of elbow extension measurement on the ipsilateral side was taken with help of half circle goniometer recorded by fellow therapist by placing fulcrum on lateral epicondyle of humerus and movable and immovable arm along the shaft of radius and humerus respectively.

Statistical Tests

Related t-test and one-way ANOVA was used compare the results.

Results

Paired t-test revealed significant difference in the median nerve sensitivity when Neutral and Horizontal Abduction positions of contralateral arm were compared. Results also demonstrated significant difference on comparison of Neutral versus Flexion positions whereas Neutral versus Horizontal Adduction positions demonstrated non-significant results.

Conclusion

Upper Limb Neural Test(1) was affected by different positioning of contralateral arm.

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Keywords

Neurodynamics, Upper Limb Neural test, Elbow extension.

Introduction

In the present situation the reported incidence of nerve injuries is high. More than 2.25 million injuries, which occur per year 93% of it claim neuritis. Those with traumatic brain injury 10-34%, have peripheral nervous system injuries. Upper limb nerves are affected more than the lower limb nerves.[13] The functional deficits observed following upper extremity nerve injuries generate deep marks on the psychosocial life of the patients.[6]

Neurodynamics, defined as the mechanical and physiological functions of the neural system has been effectively examined by selective neural tension tests. Neural tension provocation tests (NTPT) are used to evaluate the mobility and sensitivity of the nervous system. NTPT are straight leg raise (SLR), Passive knee Bend (PKB), slump test and the upper limb Neurodynamic test. These tests offer the clinician a means of detecting and determining the nature and extent of neural pathomechanics.[2] The loss of extensibility at one side may produce increasing tensile loads when the peripheral nerve or nerve root is stretched leading to mechanical dysfunction. This is the principle behind the neural tension or neurodynamic tests.[3]

Elvey (1979) first introduced the test known as the brachial plexus tension test (BPTT) to an international manual therapy conference in Melbourne. The term upper limb tension test (ULTT) was introduced by Keneally et al (1988) and also called it as the straight leg raise of the arm.[7] Butler (1991) has described ULNT(1) as a median nerve bias test. The ULNT(1) affect predominately the median nerve via the C5/6 nerve roots and to a lesser extent the C7 nerve root.[10]

Strain in the median nerve is affected during upper extremity positioning. These findings lend support to the use of upper-extremity positioning sequences in the clinic to induce nerve strain during evaluation of nerve dysfunction.[1]

Rubenach and Elvey (1985) claimed that the position and movement of the contralateral arm and the SLR could alter the symptoms provoked in an arm indicated that tension in pain sensitive structures was transmitted across the cervical spinal canal.[9] Rubenach (1985) also found that if an upper limb neural test was performed on one arm and the symptom response position maintained then the addition of the same test to the other arm would result in a change of symptoms with the majority reporting a decrease in symptoms. [4,9]

This study by Rubenach(1985) prompted me to see the effect of different positioning of the contralateral arm on upper limb neural test on the tested side.

The aim of the study is to find out the optimal position of contralateral arm during upper limb neural test so as to keep the limb in minimally stressed position when irritability of nerves is high.

Materials and Methods

The study is experimental in nature. 100 young, healthy, normal subjects with age (mean 21.62 + 1.79) and height (mean 159.83 + 1.11) without any history of cervical pain or radiation down the arm since three months were included in the study. The subjects excluded were those with recent history of trauma, inflammation, odema, lack of range of motion of joints of upper limb, irritable skin conditions eg. Dermatitis, eczema etc., paraesthesia or anaesthesia in upper limb. Subjects who could not precisely respond to maneuvers whether cognitively, psychological or for any reasons were also excluded from the study.

The operational tools used were goniometer with double arm half wide protractor and digital stopwatch (Kadio. KD-1069).

The methods used in this study is taken form journal of physiotherapy (Butler)

(1999) Inter-therapist and Intra-therapist reliability testing for ULTT.

The upper extremity to be tested was positioned with the shoulder girdle depressed comfortably by the fist. Shoulder was abducted to approximately 100-110^0. Shoulder was rotated laterally to approximately 90^0 forearm parallel to the table. Forearm was fully supinated and the wrist and fingers were extended fully. Then the subject's elbow was extended until the initial onset of stretch is felt by the subject. A fellow experienced physical therapy assistant measured the elbow extension range of motion with the help of goniometer.

Firstly the above procedure is performed with the contralateral arm in the neutral position. After a rest of 10 min the same above procedure is repeated with contralateral arm in the horizontal abduction position. Again with an internal of 10 min. upper limb neural test(I) is performed with contralateral arm in flexion and again with same time gap with contralateral arm in horizontal adductions position upper limb neural test(1) is performed.[2]

Statistical analysis

Related t-test was used to compare the effect of neutral with horizontal abduction then with flexion and horizontal adduction position of contralateral arm on upper limb neural test. Later one-way ANOVA was performed to find out the variation between different conditions in all subjects.

Results

Paired t-test revealed that there was significant difference in the median nerve sensitivity test when the contralateral limb was placed in horizontal abduction and flexion position as compared to neutral position. P-value was found to be significant. ($p<O.05$).

Table No.1

Distribution of mean values and standard deviation of upper limb neural test(1) in Neutral VS Horizontal Abduction position of the contralateral arm.

Condition	N	Mean ± S.D	t value
Neutral	100	62.62±16.83	4.35
Horizontal Abduction	100	57.79±17.06	
Significance			p<o.o5

Table No.2

Distribution of mean values and standard deviation of upper limb neural test(1) in Neutral VS flexion position of the contralateral arm.

Condition	N	Mean ± S.D	t value
Neutral	100	62.62±16.83	2.30
Flexion	100	60.02±16.24	
Significance			p<0.05

Table No.3

Distribution of mean values and standard deviation of upper limb neural test (I) in Neutral VS Horizontal adduction position of the contralateral arm.

Condition	N	Mean ± S.D	t value
Neutral	100	62.62±16.83	0.76
Horizontal Adduction	100	61.72±17.11	
Significance			p>0.05

Table No.4

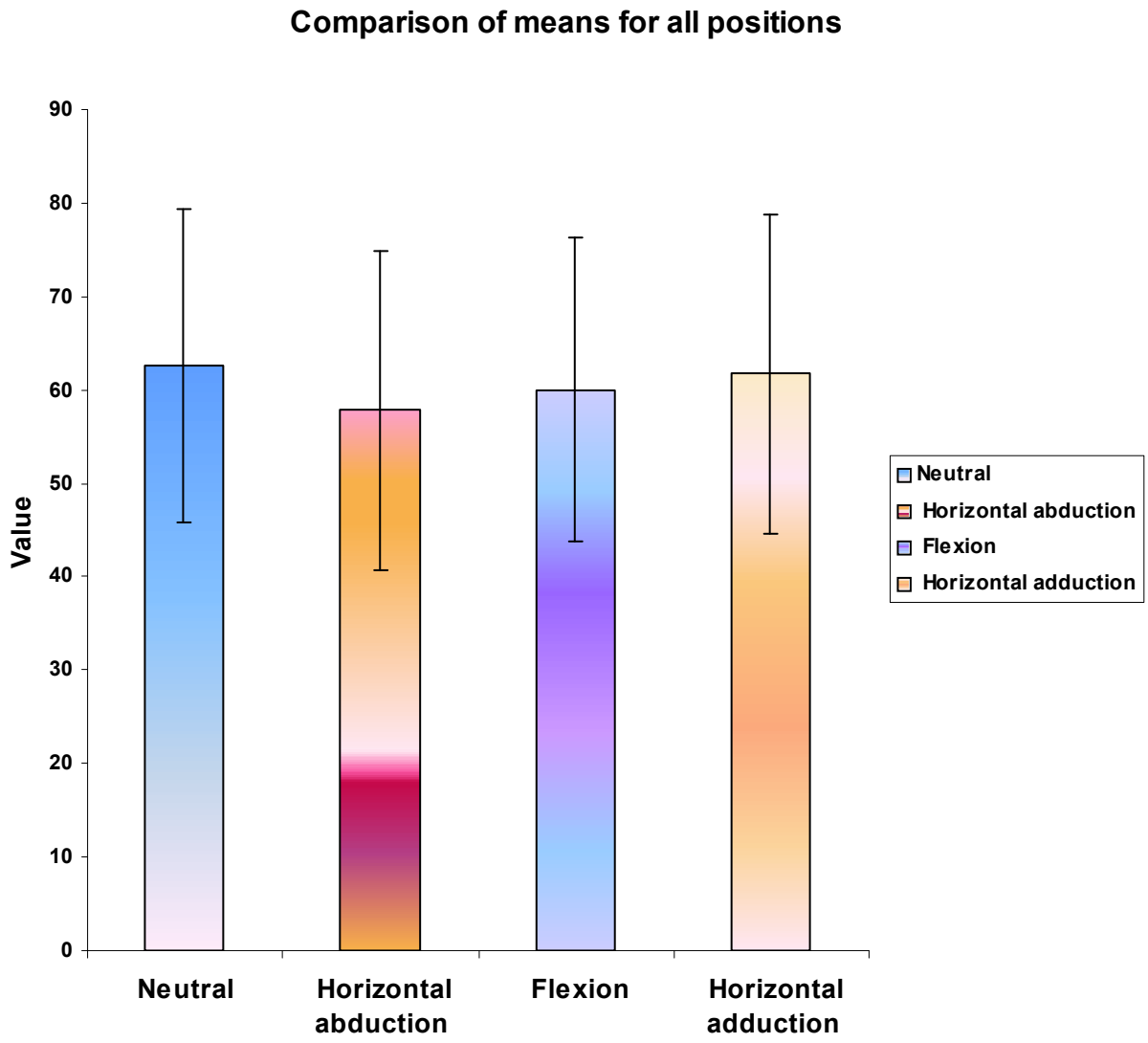
One way ANOVA between different conditions of contralateral arm

Condition	F-Value	P-Value
Neutral, Horizontal abduction, flexion and Horizontal adduction	1.58	P>0.05
Significance		p>0.05

S → Significant (P<0.76)

NS → Non- Significant (P>0.05)

On comparison of different conditions of contralateral arm among themselves, one way ANOVA was performed which revealed non significant results as P>0.05.



Graphical Representation of Comparison of means for all positions.

The results of this study showed that horizontal abduction and flexion position of contralateral arm may be the most sensitizing positions to elicit median nerve sensitivity of the tested side.

Discussion

From the results of this study we can say that horizontal abduction and flexion positions of contralateral arm may affect the median nerve sensitivity on the tested side. These results can be supported by the study of Rubenach (1985) who documented that if ULNT was performed on one arm and the symptom response position maintained then the addition of the same test to the other arm would result in a change of symptoms with the majority reporting a decrease in symptoms. Tension in the nervous system must therefore be transmitted transversely across the neuraxis.[4]

Rubenach (1985) also hypothesized that performing the ULNT on the non-affected arm produced lateral displacement of the spinal cord and brachial plexus. From her study we can say that the cause of horizontal abduction and flexion position affecting the median nerve

sensitivity may be due to the lateral displacement of the spinal cord and brachial plexus.[12] The results of this study was also supported by the finding of Elvey (1980), who claimed that movements of the contralateral arm and the straight leg raise could alter the symptoms provoked in an arm.[8]

Hammer (1997) further supported the study by claiming that because the nervous system is a continuous tract any limb movement must have mechanical consequences for nerve trunks and the neuraxis.[14]

Byl (2002) did the study to quantify the strain of the median nerve and the ulnar nerve throughout upper-extremity positioning to evaluate nerve dysfunction. He lend support to the use of upper extremity positioning sequences in the clinic to induce nerve strain during evaluation of nerve dysfunction.[1]

Dilley (2003) concluded that the median nerve is unloaded when the shoulder is adducted or elbow is flexed. This finding support the results of this study that horizontal adduction position is less sensitizing for eliciting median nerve tension test.[5]

This study showed that positioning the contralateral arm in horizontal abduction and flexion positions may affect median nerve sensitivity. Limitations of the study are that the quantitative range of motion of various joints involved was not recorded rather the range of end position was taken into consideration.The tests were performed on people with no neural irritability and altered neural responses due to compression or stretching may be having different results.Since the positions of other joints involved was not maintained by any fixating devices, human errors in reproduction of the sensitizations could have come into play.The initial onset of tissue resistance was recorded by subsequent feedback given by the subject, so chances of error may be there.

Conclusion

From the result of this study we can conclude that upper limb neural test was affected by positioning of the contralateral arm. Significant results were obtained in horizontal abduction and flexion positions of contralateral arm on the upper limb neural test (1).

Further research may contradict the findings.

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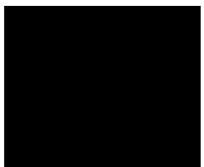

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