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# A study to analyse the effectiveness of abdominal and pelvic exercises in improving lying to sitting function in hemiplegics after stroke

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***Abstract:*** *Background-As much studies have not been done to find the effectiveness of training the trunk for a dynamic functional activity like lying to sitting, this study is intended to see the effects of abdominal and pelvic training to improve the ability of hemiplegic patient to sit up from lying position in the bed.*
*Method- Thirty stroke patients with non-traumatic vascular origin involving the middle cerebral artery were randomised into experimental and control group by simple randomization technique. 15 subjects were allotted to each group. Along with conventional therapy given to both groups, experimental group received pelvic and abdominal muscle training. Pre and post-test value of lying to sitting component of Motor assessment Scale, manual muscle testing of abdominal muscles and time duration to sit up from lying position was taken. Wilcoxon sign rank test, Mann- Whitney test and chi-square tests were used for statistics.*
*Results-The results of this study suggest that abdominal and pelvic exercises enable the patient to sit up from supine position more independently. Results also suggest that, abdominal and pelvic exercise improves the score of supine to sitting over side of bed component of MAS.*
*Conclusion- Specific abdominal and pelvic exercises should to given along with conventional therapy in stroke rehabilitation.*

***Key Words:*** *Pelvic and abdominal exercices, Lying to sitting function, Hemiplegia.*

## 1. INTRODUCTION:

Stroke is the rapid development of clinical signs and symptoms of focal neurological disturbance lasting for more than 24 hours, or leading to death with no apparent cause other than of vascular origin (WHO 2005). Stroke can be divided into two broad categories that defines its pathophysiology: Ischemic stroke, which is caused by either cerebral thrombosis or embolism and accounts for 50-85% of all strokes worldwide. Haemorrhagic stroke, which is caused by either subarachnoid haemorrhage or intracerebral haemorrhage and account for 1-7% and 7-27% of all stroke worldwide (1). Stroke increases with age; individual Indian studies have estimated that the prevalence rate increases from 21/100,000 for the 20-40 age group to 625/ 100,000 in the 60+ year age group (2). The effects of stroke are determined by the extent and site of brain injury, but the clinical symptoms of stroke do not accurately predict its underlying cause or causes. Classic symptoms include the acute onset of unilateral paralysis, loss of vision, speech impairment, memory loss, impaired reasoning ability, coma or death (3). Middle cerebral artery, accounts for almost half of all patients with ischemic strokes and have an increased risk for poor outcomes and mortality at 6 months (4).

As told by Dean et al 1998(5), ability of a patient to sit upright after stroke is very important for individuals, because sitting is a skill that is critical for independent living. “LYING TO SITTING” function requires sufficient power in the abdominal muscles and ability of the person to maintain an anterior pelvic tilt. With the exception of rectus abdominis, all the muscles of the abdominal wall are attached by more than half to the central aponeurosis which is connected to linea alba, so each side is dependent on the other for efficient action. In healthy people, electrophysiological studies using transcortical magnetic stimulation revealed that cortical pathways to trunk muscles were represented bilaterally in the cortical hemispheres, although contralateral pathways were considered dominant (6).

In hemiplegic patient abdominal muscle of the non-paretic side is also involved as it does not have a stable base for insertion (Davies PM 1990). Moving from lying to sitting position requires the abdominal muscles to move or hold the weight of the trunk against the pull of gravity, or control the speed at which it moves. The pull of the gravity is far less when body is nearer to vertical position than when in almost horizontal lying position (7) The lying position also reinforces drowsiness, confusion, and feeling of helplessness and provokes the symptom of deprivation. So, it is essential to assist the patient to sitting position, as early as possible as it gives a stimulatory effect on central nervous system, counteracts depression, enables the patient to regain control over bladder function and oral function, gives relevant visual input and encourages communication (8). Hemiplegic patients usually have difficulty in using their limb in isolation without the activity occurring in a similar pattern in their trunk or move their trunk without

movement taking place in their limbs. For e.g., when they sit up from lying position the legs will flex as well, making the movement difficult. So, strengthening exercises to the abdominal and pelvic muscles will help in lying to sitting function of hemiplegics, it also inhibits spasticity in trunk extensors and legs thus help in selective movement of the legs (Davies PM 1990).In a study, the strength of trunk flexors and extensors was determined using isokinetic dynamometer in different angles and was found that the weakness of trunk flexion-extension muscles in hemiplegic patients is accounted for, by the bilateral innervation from the motor cortex, the insufficient use of high threshold motor units and disuse atrophy (9). In addition to the impairments like reduced activity level of the lateral trunk muscles, delayed onset of, and reduced synchronization between activation of pertinent muscular pairs (10), altered trunk position sense has also been demonstrated in trunk (11). When the patient rises up to sitting position, he uses his more effective back extensors and has a difficulty in anchoring his leg on the mat. The patient finds it easier to stand up from sitting position using a more effective extensor activity of trunk and legs, rather than sitting up from lying position (7). As much studies have not been done to find the effectiveness of training the trunk for a dynamic functional activity like lying to sitting, this study is intended to see the effects of abdominal and pelvic training to improve the ability of hemiplegic patient to sit up from lying position in the bed.

## 2. METHOD:

All stroke patients with non-traumatic vascular origin involving the middle cerebral artery, aged 35 to 85 years (both males and females) with first ever episode of stroke were screened for inclusion. Patients with score of equal or less than 2 for 'supine to sitting over the side of the bed' component of Motor Assessment Scale were included in the study. They were medically stable and were able to understand and respond to verbal commands. Score of grade 2 or less in the Manual muscle testing of the abdominal muscles were included. Patient with orthopaedic and cardiopulmonary disorders, unstable vitals who cannot perform the exercises were excluded from the study. The nature and purpose of the study was explained to patients before recruiting them in the study. Informed consent was taken from every subject. Ethical committee clearance was obtained from the Institutional ethics committee. Baseline values of supine to sitting score for Motor Assessment Scale (MAS), manual muscle testing of abdominals and the time duration for supine to sitting function was taken which were used as the outcome measures. 30 subjects were recruited for the study and were randomised into experimental and control group by simple randomization technique. 15 subjects were allotted to each group

### 2.1. Procedure:

The experimental group received the following exercises:

1. Strengthening oblique abdominal muscle- Patient lies in crook lying position. The patient actively flexes and rotates the upper trunk to stimulate the oblique abdominal muscles. Patients sound side moves forward followed by hemiplegic side. Therapist may assist the movement. (Figure 1)
2. Pelvic muscle exercise- Patient in the crook lying position, tilts the pelvis anteriorly, therapist may assist and lifts the pelvis up. (Figure 2)
3. Abdominal strengthening exercise- Patient does a trunk curl ups in crook lying position.
4. Practicing normal pattern of supine to sitting technique.

Figure 1

Figure 2

The control group received the following exercises:

1. Patient in crook lying position and does pelvic bridging
2. Exercises to hemiplegic arm and leg.
3. Practicing supine to sitting technique.

Along with the above exercises, subjects in both control and experimental group were given facilitatory and active assisted exercises for all the muscle groups. Ten sessions of therapy were given to each patient (1 session per

day). At the end of tenth session, the post-test values of the outcome measures were noted. All the data were analysed using appropriate statistical tests. The pre-test and post-test values for supine to sitting over side of bed component of MAS and MMT was analysed using Wilcoxon sign rank test and between the group analyses for these outcome measures was done using Pearson's Chi- square. Pre and post-test values for time duration taken to perform lying to sitting function on the bed was measured using independent t- test.

## 3. ANALYSIS & RESULT:

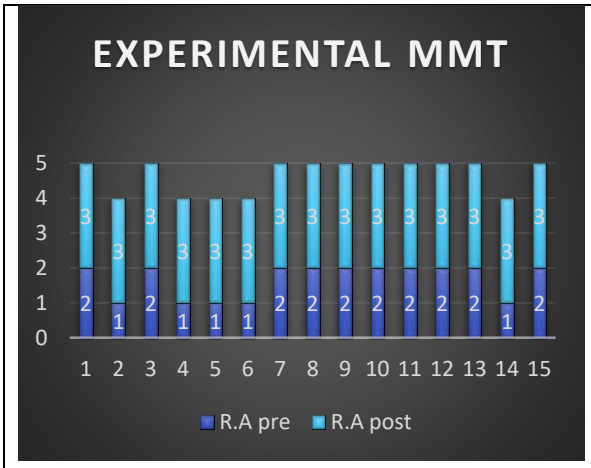
Majority of the samples were males with 25 males and 5 females. 17 subjects having right and 13 subjects having left side hemiplegia, 22 having hemiplegia due to ischemic stroke and 8 due to haemorrhagic stroke. The variables tested were supine to sitting component of Motor Assessment Scale (MAS), Manual muscle testing (MMT) of abdominal muscles and time duration required to perform the supine to sitting function.

### 3.1. MOTOR ASSESSMENT SCALE (MAS):

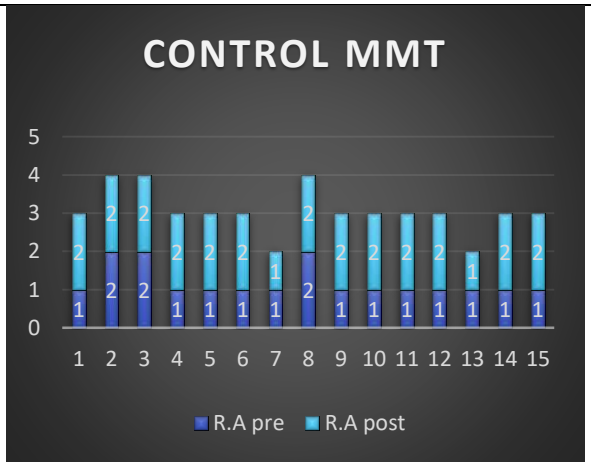
The base line value of the experimental and control group in Motor assessment Scale was similar for A-MAS (lying to sitting function by turning towards the affected side) and U-MAS (Lying to sitting function by turning towards the unaffected side) which was found by Mann-Whitney test. Within the group analysis was done using Wilcoxon sign rank test. Within the group analysis of A-MAS for the experimental group shows, highly significant with P value being .001. Within the group analysis of A-MAS for the control group shows, that it is significant with P value being .025. Within the group analysis of U-MAS for the experimental group shows, highly significant with P value being .000. Within the group analysis of U-MAS of the control group shows, not significant with P value being .083. Between the groups analysis for MAS was done using Pearson's Chi- square and subjects scoring 4 or more in post-test in lying to sitting component of MAS was taken as change and less than 4 was taken as no change. Between the group analysis showed the results are significant for A-MAS and U-MAS with Pearson's calculated value being 9.14 and 10.9 respectively for the significance level set as .05.

### 3.2. MANUAL MUSCLE TESTING (MMT):

The pre-test value for MMT of Rectus abdominis (R.A), Right side rotation (R.SR) and left side rotation (L.SR) of trunk was compared using Mann- Whitney test for both the groups and baseline value was found similar. Within the group analysis was done using Wilcoxon sign rank test with the significance level set at .05. Within the group analysis of MMT-R.A for the experimental group was found to be highly significant with the median and IQR for R.A pre intervention being 2 and 1 respectively . Within the group analysis for MMT- R.A for control group was found to be highly significant with median and IQR for R.A pre-test being 1 and 0 and R.A post-test being 2 and 1 respectively. Within the group analysis for MMT-R.SR for experimental group was found to be highly significant with median and IQR for R.SR pre-test being 2 and 0 and R.SR post-test being 3 and 0 respectively. Within the group analysis for MMT- R.SR for the control group was found to be highly significant with median and IQR for R.SR pre-test being 1, 0 and R.SR post-test being 2, 1 respectively. Within the group analysis for MMT-L.SR of experimental group was found to be highly significant and within the group analysis for MMT-L.SR for control group was also found to be highly significant. Between the group analysis for manual muscle testing for rectus abdominis (R.A), right side rotation of trunk (R.SR) and left side rotation of the trunk (L.SR) was done using Pearson's Chi-square and was found to be significant with Pearson's chi- square value as 30, 22.94 and 16.42 respectively for the level of significance set as .05.




GRAPH 1 - BAR DIAGRAM FOR RECTUS ABDOMINIS (R.A) PRE AND POST FOR EXPERIMENTAL GROUP




GRAPH 2- BAR DIAGRAM FOR RECTUS ABDOMINIS FOR CONTROL GROUP

**3.3. TIME DURATION**:

The normality of the curve for the experimental and control group for the time duration was found by Shapiro-Wilk test and was found to be normal in both the groups. Within the group analysis was done using paired t test. Within the group analysis for the time duration to sit by turning towards the affected side and sit up by turning towards the unaffected side in both experimental and control group was done and was found as not significant. Independent t-test was used for between the group analyses for the time duration to sit by turning towards the affected side (A.TD) and unaffected side (U. TD) and was found to be not significant with significance level set as .05

**4. DISCUSSION:**

Among the subjects recruited for the study, the number of patients with ischemic stroke were more than hemorrhagic stroke because ischemic stroke accounted for 50-85% and hemorrhagic stroke accounted for 7-27% of all strokes worldwide (1) and number of male subjects were more than female as according to Sethi (2002), men are more likely to have a stroke than women, the male/female sex ratio for India being 7:1. In this study, both the group showed improvement in MAS score for turning on to the affected side and sitting, but the improvement in the experimental group was found to be highly significant when compared to the control group which was significant. Turning on to unaffected side and sitting was found to be highly significant in experimental group and not significant in control group in Wilcoxon sign rank test. Between the groups analysis was done by Pearson's chi- square. Score of 4 was set as a value to categorize the patient as change and no change because in this score the patient sits over side of the bed without any assistance. The results for turning towards affected side and sitting and turning towards unaffected side and sitting were significant. In this study the improvement in MAS scores for the patients by turning towards affected side and sitting, and turning towards unaffected side and sitting was similar. The reason behind this could be because trunk muscles have a bilateral innervation, so the affected side of the abdomen is also supplied by uncrossed cortical fibers of the normal hemisphere so as expected that turning towards normal side and sitting up will be more difficult than turning towards the affected side and sitting up does not hold true, supported by a study by Toshiyuki Fujiwara et al 2001(12) on motor evoked potential in external obliques of both sides of hemiplegic patient which was found to be similar. Maximum improvement was seen mostly in patients who were in the age group between 45-70 yrs., for the lying to sitting component of MAS. The entire patient had baseline value of 2 in MAS in both the group at the start of the study i.e., they had neck control throughout the lying to sitting activity. There was no significant difference found in the patients having either ischemic stroke or hemorrhagic stroke, male or female, Left or right sided hemiplegia and their scoring in MAS. The score of MMT of rectus abdominals, right and left side trunk rotation showed highly significant values for both the groups, when within the group analysis was done using Wilcoxon sign rank. Between the groups analysis for MMT scoring was done using Pearson's chi- square with 3 set as a score in post-test value to categorize the patient as change and no change, and the results were found to be significant. It is found in this study that MMT of rectus abdominis is improved more than the obliques in both the groups, the reason behind it could be because unlike obliques, the rectus abdominis has a stable base of insertion. Also, in a study it was found that the strength hierarchy of trunk consists of from strongest to weakest: extension, flexion, side bending, and rotation. There was improvement, but not marked in the MMT scoring of abdominal muscles post treatment in the experimental group, this could be because the number of training sessions was less in this study. As WimSaeys et al in 2012(13) proved in his study that 16 hours of specific truncal exercises, in addition to conventional therapy was required to benefit truncal function in stroke patients and another study done by Kwakkel et al in 2004 which says that 15 hours of extra trunk training is needed to achieve a clinically relevant increase in functional scores. In this study only 10 sessions of training was given, because hospital stay for post stroke patients were limited to 10-12 days in average, in this hospital. The time duration required to sit up from the bed did not show marked improvement, or had decreased post-test in few patients. The reason behind this is that patients had an improvement in the quality and independence in performing lying to sitting function, but took more time to perform it, than during pre-test measurement where they required more assistance by a therapist so, the time required to perform this function was therapist dependent.

Training the trunk muscles not only improved the lying to sitting function but it was also found that the patients in experimental group started ambulating earlier than the control group and were able to perform reaching activities much earlier and better than control group. The reason for this could be that, the patients in experimental group were able to stabilise their proximal segment much better for the arm to perform the reaching activity and were also able to do lateral flexion of trunk if the reaching activity was done beyond a limit. There are many studies which support this, like one study states that trunk muscle plays an important role in stabilisation of the proximal part, thus improving voluntary limb movement and ability to perform various ADL's like reaching, walking etc. (14).

**5. CONCLUSION:**

The results of this study suggest that abdominal and pelvic exercises enable the patient to sit up from supine position more independently. Results also suggest that, abdominal and pelvic exercise improves the score of supine to

sitting on bed component of MAS. So as hypothesized abdominal and pelvic exercise in adjunct to conventional physiotherapy improves the lying to sitting function in hemiplegic patients post stroke

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