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Original Research Article

Dynamic Sitting Exercise for Mechanical Low Back Pain

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ABSTRACT

The aim of this study was to investigate the Effects of Dynamic Sitting Exercises in patients with Mechanical Low Back Pain.

Study Design: Forty subjects participated in this study who had mechanical low back pain. Subjects were randomly assigned to two groups: Experimental and Control group. Experimental group followed Dynamic Sitting Exercise and the Control group followed Conventional Low Back Pain treatment. Pain was measured using Numerical Rating Scale, ROM using Lumbar Schober test and functional independence using Roland Morris Disability Questionnaire.

Results: After the experiment, lumbar ranges and functional independence showed statistically highly significant difference; also pain levels reduced significantly which was measured using the Numerical Rating Scale in the experimental group. There were significant differences in lumbar range of movement of both flexion-extension and side flexion between the groups.

Conclusion: These results suggest that Dynamic sitting exercises performed during a 1-hour period for 4sessions improved lumbar mobility, reduced pain and improved functional independence in comparison to the conventional LBP treatment exercises.

Key Words: Dynamic Sitting Exercise, Mechanical low back pain.

INTRODUCTION

Low Back Pain (LBP) is a Worldwide Problem and a major cause of disability in general population. Low Back Pain is the 5th most common reason for physician visit, which affects nearly 60-80% of people throughout lifetime. [1] Low socioeconomic status, poor education, physical factors such as lifting heavy loads, repetitive job, prolonged static posture and awkward posture, psychosocial factors such as anxiety, depression, job dissatisfaction, lack of job control and mental stress, working hours and obesity have been found to be associated with LBP. [2] Almost 95% of the population presenting with LBP have mechanical causes. [1] Mechanical LBP generally occurs with acute onset, morning stiffness present and nocturnal symptoms absent with no sacroiliac joint involvement. It refers to any type of back pain from T12 level till Gluteal fold and does not have a specific cause. [1] One of the primary causes of back pain is a sitting posture sustained over long periods. [3] Approximately 76% of Computer professionals from India reported musculoskeletal discomfort in various epidemiological studies (Talwar R et al., 2009; Bhanderi D et al., 2007; Sharma A et al., 2006 & Bakhtia CS et al., 2003). [4] With every posture attained in the day, there is compression load on the spine. The weight of the body and gravity causes compressive effects on the intervertebral discs and facet

joints. The disc bears about 80 percent of the spinal compressive load, and the facets bear the remaining 20 percent. [5] Also, studies were done which demonstrated the relative spinal pressure in lower lumbar discs in various positions and with various exercises, it concluded that highest pressure is exerted when picking a small thing from floor while sitting followed by when walking, standing and sitting. [6] Due to prolonged sitting the IVD area decreases by 18.6 mm3, lordotic angle decreases by 6.2 degrees and height of lumbar spine decreases by 12.5 mm. [7] Exercise programs are an important treatment and a form of rehabilitation for LBP. [3] Various exercises have elicited positive effects in patients with LBP and lumbar instability. Juni et al found that the addition of spinal manipulative therapy to standard care is unlikely to result in relevant early pain reduction in patients with acute LBP. [8] Dynamic sitting exercises (DSE) have proved to provide therapeutic effects for preventing decreases in the LROM and reduce LBP in normal individuals. [3] The DSE to be used is modified from the chair-care decompression exercises. It is a combination of lower back hyperextension and abdominal drawing-in exercises. [3] It also helps in muscle activation as hypothesis says that frequency of muscle activation is a key factor in maintaining a healthy low back. [9] There are no studies done which help us to know about the therapeutic uses of this exercise. Therefore, studies are needed to find the effects of Dynamic Sitting Exercise in individuals having Low Back Pain. The aim of the present study was to investigate the effects of dynamic sitting exercises in patients with Mechanical Low Back Pain. Dynamic exercise also represents an important instrument for assuming a proper posture under spinal loading conditions during sitting. [2] Moreover, it can provide useful information to advance our understanding and rehabilitation of LBP, which, in turn, may provide new approaches towards preventing LBP.

MATERIALS AND METHODS

Participants were included in the study according to inclusion and exclusion criteria. Inclusion criteria was participants having Mechanical low back pain and those who have a prolonged sitting posture > 8 h/day for 5 days. Participants were excluded if they had any History or presence of radicular pain, Specific physical condition such as nucleus pulposus prolapse, tumor, spondylolisthesis, spinal stenosis, or cauda equine syndrome, Red flags according to the current guidelines of back pain, including history and presence of inflammation, tumor, trauma, and neurological deficits ruled out by clinical, radiological, or laboratory examination and Systemic diseases like rheumatoid arthritis, Crohn's disease, diabetes mellitus, cancer, or psychiatric disease. The outcome measures included pain levels, Lumbar ROM and functional independence which were measured with the visual analog scale (VAS), the Modified Lumbar Schober test (MLST) and the Roland Morris Disability Questionnaire (used in English, Hindi or Marathi depending on subject's understanding) respectively. The MLST was used to measure ROM in both lumbar flexion and extension. [10] A point was marked midway between the two PSIS (dimples of pelvis), which is the level of S1; then 5 cm below it was marked as landmark 'X' and 10 cm above the point was marked as landmark 'Y'. The distance between the three points was measured (15 cm) using measuring tape and then the subject was asked to flex forward and try touch fingers to toe keeping knee straight for Lumbar Flexion. Also, was told to look up to the ceiling as much as he could do for Lumbar Extension. The LROM for flexion and extension were assessed by the distance between two points. An increased flexion distance and a decreased extension distance indicated a better LROM. The difference in the measured distance was taken from the total distance (15 cm) as the LROM. These measurements were taken three times and

the mean value was used for further analysis.

The VAS is a common assessment of pain intensity in clinical and research settings. [11] A pain scale measures a patient's pain intensity or other features. Pain scales are based on self-report, observational (behavioral), or physiological data. The VAS is rated by a subject on a scale drawn on a 10-cm long line, with 0 indicating no pain and 10 indicating intolerable pain. Subjects were asked to make a mark on the line commensurate with their perceived levels of pain intensity.

The Roland Morris Disability Questionnaire (RMDQ) is a self-reported outcome measure that was first published in 1983. [12] It provides a tool for measuring the level of disability experienced by a person suffering from LBP. Since then, it has become one of the most widely used outcome measures for LBP. Despite the various adaptions of the RMDQ, the original is still the most widely used and validated. So, the original 24-point scale was used for the study. Both internal consistency (Cronbach's $\alpha = 0.84$ to 0.96) and test-retest reliability ($r = 0.83$ to 0.91) of the RMDQ are good. The RMDQ consists of 24 statements relating to the person's perceptions of their back pain and associated disability. This includes items on physical ability or activity (15), sleep/rest (3), psychosocial (2), household management (2), eating (1) and pain frequency (1). [12] It is designed to take approximately 5 minutes to complete, without any assistance from the administrator. The subjects were given the scale according to the language understood in English, Hindi or Marathi. The subjects were explained to tick on the statement they

Forty subjects were taken having Mechanical LBP. All the subjects went through a physical screening performed by a physical therapist. Subjects who have undergone Hip joint or lower limb surgeries, or having radiating B/L lower limb pain, Prolapsed Intervertebral Disc, Scoliosis, Ankylosing spondylitis, Spondylolisthesis, Rheumatoid Arthritis or Any other spinal pathology were excluded in this study. An experimental type of study was conducted and subjects were divided by method of systemic sampling. The subjects were divided in 2 groups having 20 subjects each: Experimental and Control Group. Experimental group followed Dynamic Sitting Exercise and the Control group followed Conventional Low Back Pain treatment. For screening of subjects their endurance of core muscles was assessed to know whether they are capable enough to do the exercises. Written informed consent was obtained from each participant. The study was approved by institutional ethical committee. The assessments of each group were performed before and after the intervention. The interventions were based on outpatient rehabilitation programs in both groups with respect to dosage and contents. A total of 40 patients participated in the study. They were randomly distributed in two groups equally, i.e. 20 in each. Group I included study participants to be treated by conventional treatment approach. The subjects in this group received hydro collator packs for 10 minutes followed by conventional protocol for LBP patients. Which included the following exercises**:** Static Back (Hold for 10 counts), Cat-camel exercise and Single Leg Raise in quadruped position (Frequency- 5 repetitions/set), Abdominal Curl-ups and Bridging (Frequency- 5 repetitions/set). Group II included study participants to be treated by dynamic sitting exercises. The subjects in this group received hydro collator packs for 10 minutes followed by DSE. The DSE was modified from the chair-care decompression exercises. It was a combination of lower back hyperextension and abdominal drawing-in exercises. Subjects were instructed to perform the following sequence of actions: 1) Relax their arms on the armrests, 2) Extend the lower back until they could feel slight stretching in the lower back and hold for 5secs, then 3) Gently draw in abdomen to return to the neutral sitting posture in 1-5

sec. [3] This exercise was performed six times in a 1-minute period and repeated every 20 minutes while sitting over a 2-hour period. This was repeated for4 sessions in a week. Prior to the experiment, each subject was given an explanation and demonstration of how to perform each step of the DSE. In addition, prior to the experiment all the subjects were asked to go to the restroom and perform their ablutions, as they were not allowed to leave the chair during the experimental period.

Statistical Analysis: The obtained data was calculated using SPSS. The relative values for each individual subject before and after the experimental protocol was compared using paired-t test. After that, the independent t-test was used to compare the relative changes between the two treatment groups. Statistical significance was accepted for values of $p < 0.05$.

RESULT

The data derived from both the groups were compared statistically using Wilcoxon Signed Rank test and Mann Whitney U test. The change between the pre-and post readings of every individual for pain, lumbar ROM and functional independence was done using Wilcoxon Signed Rank test. The comparison between the Experimental group and Control group was performed using Mann Whitney U test

Table 1: Pre-& Post mean VAS of Experimental and Control group

	Experimental Group			Control Group		
Pain on VAS	Pre	Post	P Value	Pre	Post	P Value
At Rest	2.9 ± 1.44	0.6 ± 0.58	0.00	2.9 ± 1.68	1.7 ± 1.16	0.000
On Activity	6.9 ± 1.16	2.1 ± 1.2	0.00	6.1 ± 1.41	6.1 ± 1.41	0.000

Inference: There is a statistical significant difference in VAS pre and post intervention in both experimental & control group.

Table 2: Pre-& Post mean Lumbar Spine ROM of Experimental and Control group

	Experimental Group			Control Group		
Range of Motion	Pre	Post	P Value	Pre	Post	P Value
Flexion (cm)	2.2 ± 1.01	5.6 ± 0.55	0.00	3.3 ± 1.08	4.4 ± 0.82	0.000
Extension (cm)	1.3 ± 0.92	3.6 ± 0.39	0.00	2.1 ± 0.82	2.8 ± 0.58	0.000
Right Side Flexion (cm)	9.5 ± 2.48	13.3 ± 2.73	0.00	10.6 ± 1.87	12.1 ± 1.87	0.000
Left Side Flexion (cm)	9.6 ± 2.58	13.4 ± 2.58	0.00	10.6 ± 2.08	12.1 ± 1.84	0.000

Inference: There is a statistical significant difference in lumbar ROM pre and post intervention in both experimental & control group

Table 3: Pre-& Post mean RMDQ score for Functional Independence of Experimental and Control group

	Experimental Group			Control Group		
	Pre	Post	P Value	Pre	Post	P Value
RMDQ score	12.1 ± 3.18	5.5 ± 2.76	0.00	11.1 ± 2.77	8.4 ± 2.62	0.000

Inference: There is a statistical significant difference in functional independence(RMDQ score) pre and post intervention in both experimental & control group

Table 4: comparison of mean difference of VAS between the Experimental group and Control group for pain

	Experimental Group	Control Group	P Value
Pain on VAS			
At Rest	2.2 ± 1.28	1.15 ± 0.81	0.004
On Activity	4.8 ± 1.23	1.95 ± 0.75	0.000

Inference: There is a statistical significant difference in VAS between experimental & control group

Table 5: comparison of mean difference spinal ROM between the Experimental group and Control groups

Range of Motion	Experimental Group	Control Group	P Value
Flexion (cm)	2.5 ± 0.68	1.05 ± 0.68	0.000
Extension (cm)	1.65 ± 0.74	0.8 ± 0.76	0.002
Right Side Flexion (cm)	3.8 ± 1.15	1.6 ± 0.82	0.000
Left Side Flexion (cm)	3.8 ± 1.47	1.55 ± 0.88	0.000

Inference: There is a statistical significant difference in lumbar ROM between experimental & control group

Table 6: comparison of mean difference RMDQ score for Functional Independence between the Experimental group and Control group

	Experimental Group	Control Group	P Value
RMDQ score	6.65 ± 1.75	2.7 ± 0.86	0.000

Inference: There is a statistical significant difference inRMDQ score for Functional Independence between experimental & control group

DISCUSSION

An unprecedented evidence indicating that Dynamic Sitting Exercises in patients with Mechanical Low Back Pain can reduce pain, maintain lower back mobility of both flexion and extension as measured by the modified Schober test and improve functional independence was given by this study. Because a decrease in lower back flexibility is one of the major causes of lower back problems, DSE may be an important technique for preventing low back problems.

The demographic data represented that the highest percentage of subjects having mechanical LBP were Desk job workers by occupation and their mean age was 31 years old which is also supported by a systematic study review done by, Chen et al which investigated whether a sedentary lifestyle (which the authors defined as including sitting for prolonged periods at work and during leisure time) is a risk factor for LBP. [13]

It was observed that the Pain levels had significant reduction which were helpful for the subject to resume his daily routine faster which was reflected in the scores for functional independence. Research since the late 20th century suggests that chemical causes may play a role in the production of pain in mechanical LBP. [14] This concept postulates that the components of the nucleus pulposus, most notably the enzyme phospholipase A2 (PLA2), may act directly on neural tissue, or it may orchestrate a complex inflammatory response that manifests as LBP. The response results in compression of the DRG and stimulates release of substance P. Substance P, in turn, stimulates histamine and leukotriene release, leading to an alteration of nerve impulse transmission. The neurons become sensitized further to mechanical stimulation, possibly causing ischemia, which attracts polymorphonuclear cells and monocytes to areas that facilitate further disk degeneration and produce more pain. [14] The theory behind DSE is that significant distractive forces, when applied to lumbar spine in variable directions can create a negative pressure in center of IV discs, [15] thereby creating a suctioning effect or vacuum phenomenon in order to retract or reduce the size of disc's gelatinous internal nucleus pulposus, thus diminishing or eliminating nerve compression thereby reducing pain. [16] At the same time, it creates an osmotic gradient which helps bringing in nutrients, oxygen and water into the disc. [9] The previous study done by Uraiwan ChatChawan1, using DSE on normal individuals had shown subjects in the DSE group had a slightly higher increase in pain intensity than those in the Control group. [3] The reason could be that the subjects taken in the study had absolutely no pain at rest or on activity and that the study had taken immediate effects after 2 hours.

Also, an increase in the lumbar ROM was observed after the 4th session.The lumbar flexion ROM was observed to increase more than extension ROM. Abdominal in drawing helps in improving strength of muscles providing lumbar stability. They are internal and external obliques, transversus abdominis and lumbar multifidus. [9] In addition, enhancement of spinal height may be explained by similar effect of "off- loading posture" using dynamic sitting exercises. [15] Studies were done to evaluate the effects of DSE on normal individuals which showed that these exercises increase the IVD area by 87.9mm3, lordotic angle by 5 degrees and the height of lumbar spine by 21.9mm. [7] Thus, the combination may increase the extensibility of the non-contractile capsular & ligamentous tissues around spine, thereby enhancing spinal mobility and improving LROM. Also, previous studies done by Uraiwan Chat Chawan, showed that LROMs of both flexion and extension were significantly greater in the DSE group than in the Control group. [3]

CONCLUSION

Dynamic sitting exercises improved lumbar mobility, reduced pain and improved functional independence in comparison to

the conventional LBP treatment exercises in patients with Mechanical Low Back Pain. Thus, our findings may contribute to the advancement of the general understanding of mechanical LBP and broaden the treatment options for rehabilitation program planning and can be used as a new approach for treatment. Future studies are needed to determine the clinical efficacy of dynamic sitting exercises over the long term and with a large sample size.

REFERENCES

1. Burton AK, Tillotson KM, Main CJ, Hollis S. Psychosocial predictors of outcome in acute and subchronic low back trouble. Spine .1995 Mar 15;20(6):722-8.
2. Supreet Bindra1, Sinha A.G.K.1 et al. Epidemiology of low back pain in Indian population: A Review. International Journal of Basic and Applied Medical Sciences. 2015; Vol. 5 (1): 2277-2103.
3. ChatChawan U, Upamatangb J et al. Immediate effects of dynamic sitting exercise on the lower back mobility of sedentary young adults. J. Phys. Ther. Sci. 2015; 27: 3359–3363.
4. Shahul P. Prevalance Of Work Related Low Back Pain Among The Information Technology Professionals In India – A Cross Sectional Study. International journal of Scientific & Technology Research. July 2013; Volume 2, Issue 7 : 2277-8616
5. Joseph D. Kurnik, DC. Exercises for Back Pain: Low-Compression Training Program. Dynamic Chiropractic. June 1; 2013, Vol. 31, Issue 11
6. Nachemson AL. The Lumbar Spine, an Orthopaedic Challenge. Spine. 1976; 1(1): 61.
7. Fryer J, Quon J, Smith F. Magnetic resonance imaging and stadiometric assessment of the lumbar discs after sitting and chair-care decompression exercise: a pilot study. March 02, 2010.
8. Juni P, Battaglia M, Nuesch E, et al. A randomised controlled trial of spinal manipulative therapy in acute low back pain. Ann Rheu Dis. 2009 Sep; 68(9):1420-7.
9. Areeudomwong P, Puntumetakul R et al. Core stabilization exercise improve pain intensity, function disability and trunk muscle activity of patients with lumbar instability: a pilote randomized controlled study. J Phys Ther Sci. 2012; 24: 1007–1012.
10. Williams R, Binkley J, Bloch R, et al. Reliability of the modified-modified Schöber and double inclinometer methods for measuring lumbar flexion and extension. Phys Ther. 1993; 73: 33–4.
11. Huskisson EC. Measurement of pain. Lancet. 1974;2:1127–31.
12. Matthew S, Chris G et al. The Roland Morris Disability Questionnaire. Journal of Physiotherapy. April 2016 ; 62(2) : 116
13. Chen SM, Liu MF, et al. Sedentary lifestyle as a risk factor for low back pain: a systematic review. *Int Arch Occup Environ Health.* 2009 Jul; 82(7): 797-806.
14. Alemo S, Sayadipour A. Chronic Mechanical Lower Back Pain. J NeurologOrthop Med Surg. 2008; 28(1) :5-11.
15. Fryer J, Zhang W. Preliminary investigation into a seated unloading movement strategy for the lumbar spine: a pilot study. J Bodyw MovTher. 2010; 14: 119–12
16. Olivier N, Thevenon A, Berthoin S, et al. An exercise therapy program can increase oxygenation and blood volume of the erector spinae muscle during exercise in chronic low back pain patients. Arch Phys Med Rehabil. 2013; 94: 536–542.

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