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ORIGINAL PAPER

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Effects of bridging and V-sitting exercises on pain intensity and disability of patients with non-specific chronic low-back pain

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ABSTRACT

Introduction. Exercises are important in the management of non-specific chronic low-back pain (NSCLBP).

Aim. The study compared the effects of bridging and V-sitting exercises on pain and disability of patients with NSCLBP.

Material and methods. 34 patients with NSCLBP recruited for the study were allocated into V-sitting (VSG) and Bridging Exercise group (BEG) equally. Participants in VSG and BEG groups performed V-sitting and bridging exercises respectively for 10 seconds, three times in a week for three weeks under a supervision of one of the authors. Each participants underwent ten sessions per a treatment regimen. Pain intensity and disability were assessed at the pre-intervention, second and third weeks using verbal rating scale and Rolland Morris Low Back Pain Disability Questionnaire prospectively.

Data were analyzed using descriptive and inferential statistics, alpha level was set at 0.05

Results. There was a significant reduction in the third week ($P < 0.001$) in both VSG and BEG group of pain intensity and disability comparing the pre intervention, second and third week values. There was a significant reduction in the 3rd week VSG's pain intensity ($F=27.34$ $P<0.001$) and disability ($F=14.96$, $P<0.001$) compared with BEG.

Conclusion. V-sitting and bridging exercises were effective in management of patients with NSCLP, but V-sitting seems more effective.

Keywords. bridging exercises, disability, low back pain, pain intensity, V-sitting exercise

Introduction

It has been stated that an unstable spine due to muscle weakness reduces endurance flexibility and the range of motion of the lower back, in addition to causing pain.[1] This on the other hand results into reduction in back muscles cross-sectional area on account of reduction and limitation to functional usage and physical activity.[2,3] Moreover, the physical causes of low back pain can

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Participation of co-authors: A – Author of the concept and objectives of paper; B – collection of data; C – implementation of research; D – elaborate, analysis and interpretation of data; E – statistical analysis; F – preparation of a manuscript; G – working out the literature; H – obtaining funds

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be said to be muscle weakness and imbalance, produce as a result of changes in the postural mechanics, inadequate control of trunk muscle for proper stabilization and compensatory neuromuscular disorder.[4] Research has it that all this problems can be easily solved by trunk stabilization exercises and strengthening the lumber spine, which is a very valuable treatment in the management of Low Back Pain.[5,6]

Exercise therapy has been considered important from various researchers and reviews to be a key factor in the management of chronic low back pain.[7,8] Van Middelkoop, also reported that exercise therapy decreases pain intensity, alleviates disability, and improves physical functions for a long period, such as 12-months follow-up.[8] Some exercises for the management of low back pain includes: pelvic tilt, supine single and double knee to chest, supine lying alternate arm and leg, prone leg extension, prone single arm extension, prone alternate arm and leg extension, supine heel drag to extended arms, supine sit up, trunk hyperextension, abdominal hollowing, sit ups, curl ups, bridging and V-sitting exercises, William flexion exercises, bird dog, Basquet hang, side bridge, inclined sit up, crossed long lying sit up, bench trunk curl up to mention but few.[9-13] Most studies include that active exercise are valuable therapeutical approach to the management of low back pain, despite the lack of consensus on the optimal exercise technique, intensity or active intervention.[10,13] Moreover, most clinical protocols combine different exercises with various or multiple movement techniques and position.[5] Only few of these stabilization exercise position and techniques have been proven by studies to be effective in the management of chronic low back pain as whereby efficacy of one over the other is yet to be proven.[14]

The V- sitting posture stabilization exercise program is believed to eliminate the movements of other segments while slightly flexing the hip and slowly lifting the upper portion of the body, by contracting the trunk flexors and the back extensors simultaneously is an effective means of strengthening the abdominal muscles.[15] The diaphragm and the pelvic floor muscles that make up the roof and the floor respectively, contract rhythmically during the V-sitting position exercise, this contraction contributes to spinal stability with increased intra-abdominal pressure thus creating a rigid spine.[16] Hayashi, reported that exercises that involves the flexing of the trunk and the hip with the feet raised above ground level strengthens the trunk.[15] Researchers have demonstrated that exercise on an unstable or compromised support surface (sitting with ischial tuberosity alone with the leg suspended above the ground) further enhanced changes in the motor control system, increased the muscle activity, contraction speed, strength of spinal stabilization, and improved the harmony of neuromuscular reflex reactions.[17]

Bridging exercise is an exercise which control weight load by pressing the feet against a support surface, which plays a role in controlling body balance and power to maintain position.[18] It is performed to promote coordinated contraction of global muscle and local muscles in a position in which patients (with NCLBP) feel comfortable, as a result of the reduction pain.[19,20] It is done to increase the power of the hip extensors, and also for the purpose of achieving trunk stability.[21]

Stabilization exercises have been observed to involve combination of various movement and many activities in a single exercise treatment for the management of low back pain. Although, not so much have been done to rate the effect of one stabilization exercise over the other.[22,23] However, it is not clear if there can be an exercise with just a single movement technique that may be as effective as others and can prevent both therapist and patient from going through various exercise protocol and movement combinations.

Aim

This study was designed to compare the effectiveness of these two stabilization exercise protocol, bridging exercise (a multiple movement technique) and the V-sitting stabilization exercise protocol (a single movement technique) in terms of both pain and functional disability for the management of NSCLBP.

Material and methods

Participants

The quasi-experimental study employed participants with chronic low back pain patients referred for treatment at the Department of Physiotherapy, Obafemi Awolowo Teaching Hospitals Complex, Ile-Ife, Nigeria. Inclusion criteria and exclusion criteria included patients diagnosed with non-specific chronic low back pain, i.e pain of more than 3 months, however patients with low back pain but with history of metabolic bone diseases, history of hip pathology and systemic disease were excluded from the study. Purposive sample technique was used to recruit the participants using the sample size determination formula by Rosner to know how many patients were needed for the research.[24]

$N=4\sigma^2(zcrit+zpwr)^2/D^2$

where N is the total sample size σ is the assumed SD of each group (assumed, equal for the two groups) and this is assumed to be 4.

Zcrit is the standard normal deviate corresponding to the selected significance criterion (i.e 0.05(95%=1,960).

Zpwr is the standard normal deviate corresponding to the selected power (i.e.80=0.842)

D is the minimum expected difference among the two means D=4

N=4x4^2(1.96+0.842)^2/4^2

N=31.40 N is approximately equals to 31. For attrition,

10 percent of the sample size was added, which is 3 patients, this made 34 participants i.e 17 in each group

Research protocol

The following instrument were used in the study. (i) height meter; this is a wooden meter rule of three meters high calibrated in inches and centimetre. It was used to measure the height of the participants. (ii) Tape rule. A 150 cm long and 0.7 cm wide tape rule made from China was used to measure the circumference of the participants

(ii) A Bathroom Weighing Scale manufactured by the Hanson Company of Ireland in the year 2000 (0–120 kg) was used to measure the body weight of participants in kilogram to the nearest 1.0 kg.

(iii) A hand held stop-watch is an instrument that records the time both in minutes and in seconds and was used for the participant during the exercise protocol

(iv)Verbal Rating Scale (VRS): It consists of 6 scales raging from zero to 5, zero is no pain and five is the worst kind of pain. This tool was used for patients who can articulate pain in terms of words and expression of the level of the pain. The participants placed a check mark, best to the phrase that best describe the current intensity of pain .[25] A response of no pain was given a value of zero, 1= mild pain, 2= moderate pain 3= severe pain, 4= very severe pain, 5= worst possible pain. A response of no pain at all was assigned a value of zero while the minimum pain ever felt is assign a value of one and the highest and the unbearable pain is assign the value of 5. The validity of the VRS has been established in a study conducted Akinpelu et al where they tested the visual analogue scale, the VRS and the numerical rating scale in an experimental condition in which sound was used as the stimuli it was found that these tools are reliable for pain rating and measurement.[26]

(v) Rolland Morris Low Back Pain Disability Questionnaire (RMDQ): It is a 24 item questionnaire which involves the summation of the selected items with a total of 24. The questionnaires were specific on some of the daily activities of the patients which might have been affected by pain. This is ranging from I stay at home most of the time because of my back to I stay in bed most of the time because of my back. The clinical improvement of participants were graded based on analysis of serial questionnaire and percentage of improvement were calculated. The score of equal or greater than 14 represents a significant disability associated with significant outcome.[27] Greater level of disability associated with higher score. The participant was told to mark each appropriate question and the total number of marked statement is summed up. %of clinical improvement = (difference in score)/ initial score.

Ethical of approval

Ethical of approval (HREC NO: IPHOAU/12/530) was obtained from the Health Research and Ethics Committee of Institute of Public Health Obafemi Awolowo University, Ile-Ife before the commencement of the study, the nature and purpose of the study was explained to the participants and informed consent was obtained. Participants were allocated to each group consecutively. However, if a patient was discovered unable to do V- sitting based on the severity of the pain but able to do bridging, and vice versa, such patient was allowed to that group.

Measurements

Prior to the treatment, each of the height, weight, waist and the hip circumference of each participants were measured according to Marfell et al,. The initial pain intensity and functional disability were assessed using VRS, RMDQ respectively; at baseline, second week and third week of treatment session.[28]

Intervention

The V-Sitting Exercise Protocol: Participants started the exercise in a seated position with hands and foot on the couch. The abdominal muscles and core were contracted slowly with the two legs lifted up to an extended position at a 45-degree angle with the torso. The arms were slightly flexed to about 30% but not lifted from the couch. The protocol of Quinn was used with slight moldification[29]. Participants maintained the good core posture and a strong spine throughout the movement and to avoid rounding the shoulders forward, Fig I. Participants continued to breathe deeply during the movement. The position was held for 10 seconds, participants then returned to the starting position slowly while continuing to keep the abdominal muscles engaged and tight. The procedure was repeated 5 times for a start and progressed to 10 times before the end of the study

Bridging Exercises Protocol: Glute and side bridging exercise were employed in the study, using the protocols of Quinn.[29] For the glute bridging exercise, participant lied supine on the couch, with the knees bent and feet flat on the couch, the arms were on the abdomen pronated. The hips was lifted off the ground until the knees, hips and shoulder formed a straight line Fig II. The position was held for 10 seconds before easing back down. For side bridging exercise, participants lied on the side with the forearm on the couch under the shoulder, and the feet stacked together. The hip was lifted off the couch, which created a straight line from heel to shoulder keeping the head in line with the spine Fig III.

Data analysis

Data was analyzed using the IBM version 22 (statistical package for social science student). Independent –t- test

was used to compare the physical characteristics of the participants. Repeated measure of ANOVA was used to compare the mean values of the data among the treatment sessions within and between the two groups. The alpha level of 0.05 was set as a significant level.

Results

It was observed that there were no significant difference between the physical characteristics (p=0.320), of V-sitting and bridging Exercise groups as shown in table 1.

Table 1. Comparison of the physical characteristics of participants in V-sitting and bridging exercise group (N= 34)

Variables	V-sitting n=17 Mean±SD	Bridging N=17 Mean±SD	t	p value
Age(years)	53.00±11.31	57.92±12.76	-1.017	0.320
Height(m)	1.63±0.10	1.66±0.08	-0.763	0.453
Weight(kg)	74.23±9.94	70.32±10.09	0.973	0.341
BMI (kg/m^2)	28.06±3.23	25.59±2.58	2.113	0.046
Wc (cm)	87.00±17.99	90.15±11.45	-0.527	0.603
HpC (cm)	103.42±8.59	103.00±13.26	0.920	0.927
WHR	0.84±0.17	1.15±0.88	-0.662	0.515

The results of the comparison of mean values the outcome measures for V-sitting exercise group were shown in table 2.

Table 2. Comparison among pretreatment, 2nd and 3rd week, pain intensity and disability of subjects in V- sitting group (N=34)*

Variables	Mean± SD	F	P
Pain intensity			
Pretreatment	3.42 ±0.66^a		
2nd week	2.25±0.62^b	44.420	0.001
3rd week	1.50±0.52^c		
Disability			
Pretreatment	54.51±14.15^a		
2nd week	35.07±11.44^b	27.409	0.001
3rd week	17.71±10.67^c		

*Key: Post Hoc analysis: mean difference with alphabets (a,b,c,d,e,) with different alphabets mode are significantly difference but those with the same alphabets mode were not significantly different.

There was a significant reduction (F=44.420; p<0.001) in the pain intensity when the pretreatment (3.42 ±0.66) values was compared with 2nd (2.25±0.6216) and 3rd week (1.50±0.52) values. There was also a significant reduction (F=27.409; p<0.001) in the level of disability, when the disability of pretreatment, (54.51±14.15) 2nd (35.07±11.44) and 3rd (17.71±10.67) week were compared. Post hoc analysis revealed that for the pain intensity and disability, the reduction was significant from pretreatment to 2nd and 3rd week in that order. Furthermore, the results in the bridging exercise group was presented in table 3, from the table, there was a significant different reduction (F=24.182; p<0.001) in pain intensity among the pretreatment, (3.38±0.6504) 2nd (2.38±0.6504) and 3rd week (1.62±0.6504) values.

Table 3. Comparison among pretreatment, 2nd and 3rd week pain intensity and disability of bridging exercise group subjects (N= 34)*

Variables	Mean± SD	F-ratio	P-value
Pain intensity			
Pretreatment	3.38±0.6504^a		
2nd week	2.38±0.6504^b	24.182	0.001
3rd week	1.62±0.6504^c		
Disability			
Pretreatment	53.21±16.33^d		
2nd week	38.46±13.62^e	10.461	0.001
3rd week	29.49±9.076^f		

*Key: Post Hoc analysis using LSD = mean difference with alphabets (a,b,c,d,e,) with different alphabets mode are significantly difference but those with the same alphabets mode were not significantly different

Similarly, considering the disability, a significant reduction (F=10.46; p<0.001) was observed when the pretreatment (53.21±16.33) 2nd (38.46±13.62) and 3rd (29.49±9.076) week variables were compared. Comparing the two groups as shown in table 4, there was no significant different in the pretreatment pain intensity and disability between p>0.05. With regard to the pain intensity, but there was a significant reduction (27.34, P=0.000) when the values of the 3rd week of the V sitting (1.50 ±0.52) and Bridging (1.62±0.65) exercises were compared. With respect to the disability, there was also a significant reduction (14.96, P=0.000) at the 3rd week when the V-sitting exercise group (17.71±10.6) was compared with bridging exercise group (29.49 ±9.08) as shown in table 4.

Table 4. Comparison among the pretreatment, 2nd and 3rd week of v-sitting and bridging exercise group pain intensity and disability (N=34)*

	VSG n=17			BEG n=17			F	P
Variable	PreRx	2nd week	3rd week	PreRx	2nd week	3rd week		
PI	3.42 ±0.66^a	2.25 ±0.62^b	1.50 ±0.52^c	3.38 ±0.65^a	2.38 ±0.65^d	1.62 ±0.65^c	27.34	0.000
DIS	54.51 ±14.15^a	35.07 ±11.44^b	17.71 ±10.68^c	53.21 ±16.33^a	38.46 ±13.62^d	29.49 ±9.08^e	14.96	0.000

*Key: VSG = V-sitting Exercise Group, BEG = Bridging Exercise group. PI = Pain Intensity, DIS = Disability, PreRx= Pretreatment, Post Hoc analysis of LSD= mean difference with alphabets (a,b,c,d,e,) with different alphabets mode are significantly difference but those with the same alphabets mode were not significantly different

The effect size of V-sitting exercises on pain intensity (Π^2_p = -0.103) and disability ($\Pi^2_{p=}$ -0.596) were significantly more than that bridging exercise when compared as shown in table 5.

Table 5. Magnitudes of effect size using partial Eta Square between the VSG and BEG (N=34)*

Variables	M3V	M3B	DM3	SD1	SD2	SD1+SD2	PETA (Π^2_p)
PI	1.5	1.62	-0.12	0.52	0.65	1.17	-0.103
DIS	17.71	29.49	-11.78	10.68	9.08	19.76	-0.596

*Key: M3V= Means for 3rd week V-sitting group, M3B= Mean value for Bridging exercise. DM3 = Difference between the means SD 1= Standard Deviation for V-sitting variables, SD2 = Standard deviation for Bridging variables

Discussion

The specific objectives of this study were to, determine the effect of V- sitting and bridging exercises on pain intensity and disability of patients with chronic low back pain, also to compare the effects.

The study observed a significant reduction on pain intensity and disability of subjects between the pretreatment and 3rd week in subjects with V-sitting exercise. This is inferred that V-sitting exercise is effective in the management of non-specific chronic low back pain. There is little evidence on the effectiveness of V-sitting exercise posture as a core stabilization exercise. However, Guimeres et al., pointed out in their research that investigated twelve different forms and modifications of abdominal muscles exercises which included curl-up, sit-up, V-sit exercises among others, that V-sit has the least activity involved and produces the highest level of muscle action potential in both the upper and lower part of rectus abdominis muscle with minimal level of activation in the rectus femoris as compared with other abdominal muscles exercises.[30] This was considered to be as a result of the fact that, rectus abdominis origin or insertions was not fixed as compared with other abdominal exercises in the ascending phase of the trunk and the lower limb. Mcgill has however pointed out that core stability is achieved by the ability of the abdominal muscle to create sufficient stiffness via simultaneous co-contraction and coordinated contraction of the abdominal muscles.[31] He also stated that compromised task of daily living is not compromised by insufficient strength but probably insufficient endurance and control. V-sitting posture exercise reduces disability by promoting endurance level of both the abdominal muscle and spine musculatures. Studies reported that an endurable muscle reduces the risk of back troubles in the future.[32,33] Lumber stabilization exercise including V-sitting exercises increases the strength and size of the erector spinea muscle and reduces the risk of having low back pain.[34]

It was observed that there was a significant reduction between the pretreatment, 2nd and the 3rd week of treatment, in pain and disability of subjects who received bridging stabilization exercise. This is an indication that bridging exercises were also effective in ameliorating the pain intensity and disability of patients with low back pain. Increment in muscle strength and balance in lumbar spine and relief of pain could be achieved by stabilization exercise, functional exercise, resistance exercise, and rehabilitation exercise.[35-39]

Bridge exercises have been reported to be the commonest used exercise protocol among the trunk stability exercises though in different positions with the intension to strengthen the co-activation of trunk muscles.[40,41] In addition, the superficial and deep trunk muscles were activated, gluteal and lower leg muscles were strengthened in appropriate ratio during the bridge exercises.[21] This was achieved by the usage of glute bridging exercises in the course of the study. Literature has reported that in patients with chronic low back pain, there is weakness of spinal extensors and abdominis, specifically transversus abdominis.[42] Trunk stability exercises were done to protect the spine from re occurrence of muscle damage, instability of the spine which may lead to pain and spinal degenerative changes.[41] These were achieved from our study using glute bridging exercises, hence there was reduction in pain intensity and disability index.

One of the great contributors muscles to the spinal stability is quadratus lumborum, it is as well a strong lateral stabilizer of the spine.[43] In the course of the side/lateral bridge exercise, there was strengthening of the lateral musculature specifically quadratus lumborum and the oblique group, which is another reason while there were significant improvements in the outcome measures of bridging exercises group. Exercise of sufficient duration and intensity results in the release of peripheral and central beta-endorphin which have been associated with changes in pain sensitivity.[44]

Regarding the comparison between the V-siting exercise and bridging exercise group, it was observed that there was no significant different between the anthropometric characteristics with participants in the V-sitting and bridging exercise groups. This indicated that the subjects in the two groups were comparable. Any difference obtained after intervention between the two groups was due to intervention not attributed to anthropometric variation.

This study observed a significant reduction when the 2nd week of treatment in both pain of the subjects that underwent the V-sitting exercise was compared with those subjects in the bridging exercise group. This result is in accordance with the works of other authors that specific stabilization exercise can reduce low back pain intensity and disability, or in combination with

other adjunct therapy.[45,46] Stabilization exercise also prevent recurrent episodes of low back pain.[47,48] The results of this research showed that the use of stabilization exercises is effective in the reduction of pain-related disability in NSCLBP patients. The results of this study conforms to the study of Akodu et al., who reported that stabilization exercise was effective in the management of pain and functional disability in patients with NSCLBP.[48] Shakeri et al, in their study, which focused on the effect of lumbar stabilization exercises on pain and disability in women with menstrual low back pain, the results showed that lumbar stabilization exercises improve pain and disability.[49] As well Nava-Bringas et al., in their study on the adherence to a stability exercise program in patients with CLBP, reported that there was reduction in pain, with functional improvement, and that the improvement presented more quickly than the control following adherence to a lumbar stabilization exercise program.[50]

A recent focus in the physiotherapy management of patients with back pain has been the specific training of muscles surrounding the spine (deep abdominal and lumbar multifidius), considered to provide dynamic stability and fine control to the lumbar spine.[51] A specific exercise treatment approach appears to be more effective than others commonly prescribed conservative treatment programs in patient with chronically symptomatic spondylosis or spondyloloisthesis.[52] Stabilization or core stability exercises have been suggested to reduce symptoms of low back pain and disability in patient with low back pain and form an effective treatment.[53]

Our study observed that V-sitting exercise reduced pain intensity and disability more than bridging exercises as shown in the magnitudes of the effect size using partial eta square. This may indicate that V-sitting exercise is more effective that bridging exercises. Possibly it can be inferred that the strengthening effects of V-sitting exercises is more than that of bridging exercises. By virtue of the protocol of the two exercises, V-sitting exercises strengthened the abdominal and spinal muscles as well as diagram. These are group of muscles that stabilize the low back vertebrae. The bridging exercises considering all the exercises strengthen the trunk muscles in general and pelvic muscles. Vera-Garcia et al, demonstrated that exercise on an unstable or compromised support surface like V-sitting exercises where patient is sitting with ischial tuberosity alone with the leg suspended above the ground further enhanced changes in the motor control system, increased the muscle activity, contraction speed, strength of spinal stabilization, and improved the harmony of neuromuscular reflex reactions.[17] V- sitting posture stabilization exercise eliminate the movements of other segments by slightly flexing the hip and slowly lifting the upper portion of the body, and isometrically contracting the trunk flexors and the back extensors simultaneously, an effective means of strengthening the abdominal muscles.[15] V-sitting position exercise, contributes to spinal stability with increased intra-abdominal pressure thus creating a rigid spine.[54]

Looking at it critically, it will be observed that exercises carried out in our study were majorly isometric in nature. Studies have reported that there are hypo-analgesic effects of isometric exercises especially on the contracting body part, the contralateral and a distant body part to the contracting one.[55] The implication is that central inhibitory pain mechanism is activated when muscles are contracting in a static position.[56] The process is carried out by increase in concentration of beta-endorphins, attention mechanism, activation of diffuse inhibitory controls or interaction of systems which regulate the pain.[56] In addition, pain perception was reduced as a result of isometric exercises which activates the secretion of endogenous opioid system in the brain.[43]

Conclusion

It can be concluded from this study that both the V-sitting exercise posture and glute and side line bridging exercises were effective in ameliorating pain intensity and disability of patients with non-specific low back pain. V-sitting exercise seems to have reduced pain intensity and disability better than bridging exercise.

Recommendations

Based on the outcome of this study, it can be recommended that V-sitting exercise can be incorporated for patient with non-specific chronic low back pain. However, if patient reports aggravating symptoms or unable to do it, bridging exercise can be employed.

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