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"Effectiveness of Spinal extension exercises versus core stabilization exercises with common use of Interferential therapy to improve functional ability and decrease pain in chronic low back pain patients"

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Abstract:
Background and Purpose: *The neuromuscular system acts to maintain spinal stability and reduce the impact of complex loading patterns associated with activities of daily living. During the past decade exercising the abdominal muscles has become widely used in the management of low back pain (LBP) in order to provide this supplement to spinal stability. Several exercise programs have been advocated to promote lumber stabilization but evaluation is difficult. As new training methods are emerging, a clear understanding of the efficacy of modern interventions used to strengthen neuromuscular structures to provide stability and to prevent future complications is currently considered an important area of research.*
Objective: *To compare the effectiveness of Core stabilization exercises versus Spinal Extension exercises in decreasing pain and improving functional ability in CLBP patients.*
Methods: *A convenience sample of 30 subjects were randomly selected and classified into two groups: those receiving Spinal Extension exercises, and those receiving Stabilization training. 15 subjects formed the Spinal extensor group and*
15 subjects the Core Stabilization group, both performed an exercise program for a training period of 3 weeks. A IFT program was given for a period of one week prior to the exercise program for both the groups. Statistical significance of the changes in Pain, ROM and Functional Disability before and after the program was analyzed by performing independent t test and paired t test within the group and between the groups. Outcome measures were VAS, Schobers test and ODI.
Results: *Statistical significant decrease in Pain and Functional Disability and increase in ROM were observed in subjects involved with CSEP.*
Conclusion: *This study provides one step forward in the knowledge concerning the efficacy of exercise program to strengthen the Core Stability system. The results seem to indicate that the CSEP has an ability to strengthen the core muscles, especially TRA,*
and could provide an application to aid rehabilitation of LBP individuals.
Key Words: *TRA, LBP, CSEP, IFT, Schober test, ODI and Spinal Extension exercise.*

I. Introduction

Low back pain is a common pandemic musculo-skeletal disorder, which affects the lumber segment of the spine. It can be either acute, sub acute or chronic in its clinical presentations. Empirical research has shown that physiological changes (e.g., muscle dysfunction) occur in the lumbar spine in tandem with initial episodes of pain, changes that remain after pain has subsided and although pain remains the most troublesome symptom, the condition itself is more correctly described as a disorder occurring from the low back region. In. Subjects with first-ever episode low back disorder, the epidemiological evidence indicates that over a 12-month period, 20% becomes asymptomatic, but 70% to 80% have at least 1 recurrence. A number of these subjects (3% to 4%) may have a chronic pain syndrome develop, but the largest cohort of back pain suffer are those with chronic low back disorder, who make up an estimated 73% to 77% of all patients with low back disorders.[1]

Chronic low back pain (CLBP) is defined as a back pain that last more than three months[2]. The etiology of chronic low back pain is generally unknown and the diagnostic label of non-specific LBP, is

frequently given when no specific pathological process or structure can be identified[3]. Back pain and neck pain are responsible for huge personal and social costs, and are a major cause of work disability[4]. Contrary to traditional thinking either back pain or neck pain is a problem that always resolves itself. Recurrence is usual and their course is very variable[5].

The signs and symptoms of chronic low back pain are pain in the low back region, muscle spasm, radiating in the legs, decreased range of motion of the lumbar spine, atrophy of the deep muscles of the lumbar spine, altered sensations like numbness, tingling sensation, pin pricking in the back and the lower limbs etc. The diagnosis of the chronic low back pain is done by radiological devices like x-ray, slump test, SLR test, quadrant test, one joint dysfunction test, instability test, farfan test, prone hip extension test etc.

There are numerous management protocols available for treating chronic low back pain (CLBP). Example are resistance exercises for the back extensors, proprioceptive neuromuscular facilitation exercises, endurance and strength training for the atrophied and weakened muscles, Williams flexion exercises, extension exercises (McKenzie technique), manipulative therapy, stabilization exercise and therapeutic modalities like transcutaneous electrical nerve stimulation (TENS), Inter ferrential therapy (IFT), hot packs, ice massage, short wave diathermy (SWD), ultraround (US) and various back school programmes like the European back schools etc.

Interferential therapy used in the treatment of (CLBP) has a quite a no. of evidences.. Zambito did a study on IFT in CLBP patients showed its clinical
Usefulness[6]. Anuprita Ashok did a study of horizontal therapies and interferential therapy in CLBP and showed its effectiveness. Two medium frequency currents are passed through the skin to produce a low frequency current where they intersect. This is known as "Beat Frequency". This frequency causes increased blood supply, contraction of surrounding muscles and bone healing and is used for treating musculo skeletal disorder.

Core stabilization was discovered in the late 1990s. It was derived from the studies performed on the low back pain patients who demonstrated change in onset timing (timing of onset of contraction) of the trunk muscles in back injury and chronic low back pain (CLBP) patients[7]. The research in trunk control has been an important contribution to the understanding of neuromuscular re-organisation in back pain and injury. As long as four decades ago it was shown that motor strategies change in injury and pain[8]. Training of these specific muscles lead to the cure of the back pain and return of the normal biomechanales of the spine. The core has been described as a box with abdominals in front, paraspinales and gluteals in the back, the diaphragm as the roof and the pelvic floor and hip girdle musculature as the bottom[9.10]. During back pain and any back injury these physiology of these core muscles gets altered. These muscles get weaker and atrophied. Their onset timing (timing of onset of contraction) gets changed and these leads to altered or faulty biomechanics. As a result there is injury and re-injury of the joints and soft tissue structure. Pain, muscle spasm, this vicious cycles persist and give rise to chronic low back pain (CLBP). Training of these specific muscles is thought as rehabilitation, preventive and

Strengthening regime of the spine [11]. These regimes are divided into two different stages. In the first stage isolated contraction of their muscles is attempted in various positions. Once the trained muscle gets activated, movements are performed in various other positions. Finally exercises are performed in positions, which provide the muscle a greater challenge to maintain stability.

Core strengthening is defined as the muscular control required around the lumbar spine to maintain functional stability[9]. The abdominals, which serve as a vital part of the core, plays a very important role in stabilization the spine. In their regard transverses abdominis has acquired special attention Isolated activation is achieved through performing abdominal hollowing exercises. The transverses abdominis along with external oblique, internal oblique increase the intra abdominal pressure from the hoop created via the thoracolumbar fascia, thus imparting functional stability to the spine (lumbar spine). The paraspinals are the major lumbar extensor. There are two major groups of lumbar extensors. The erector spinae and local muscles (rotators, inter trasversary and multifidus). They control intervertebral motion of two or three spinal levels. They acts as local segmental stabilizers of the spinal column. Multifidus is thought to get atrophied in patients with low back pain[12].

MC Gill states quadrates lumborum is a major stabilizer of the spine, typically working isometrically. The thoracolumbar fascia acts as a "nature's" back belt. It acts as a retinacular strap for the muscles of the lumbar spine. The thoracolumbar fascia functions as a link between the upper limb and the lower limb. With contraction of
Muscular elements, the thoracolumbar fascia acts at an activated proprioceptor, like a back belt providing a feedback in lifting activities. Hip girdle musculature plays an important role within the kinetic chain-particularly for all ambulatory activities in stabilization of the trunk and pelvis and in transferring forces from the lower extremities to the pelvis and spine [13]. When there is lower extremity instability and low back pain (LBP) there occurs delayed firing and poor endurance in the hip extensors (gluteus maximus) and abductor (gluteus medius)

muscles[14]. In a prospective study Nadler et al showed that a significant association between hip strength and imbalance of hip extensors measured during pre participation physical activity and the occurrence of LBP in female athletes over the ensuring year[15]. Psoas major is attached to the lumbar spine which helps in aiding the spinal biomechanics and to flex the lumbar spine. Diaphragm is another important part of the core muscle. It serve as the roof of the core. It contracts, intraabdominal pressure increase and imparts stability to the spine. Recent studies have indicated that people with sacroiliac dysfunction have impaired recruitment of diaphragm and the pelvic floor muscles. Strengthening of diaphragm is important part of core stabilization.[9]

Exercise for the core musculature should start on a motor learning of the inhibited muscle. Initially the exercise should be started in the neutral spine position and performed to non-neutral positions. Neutral spine position is the pain free position for performing the exercise. Prone and supine exercises should be started on the floor followed by Curl up, Side Bridge and bird dog exercises on the floor. Then progress to gym ball exercises and at last leg press.

In spinal extension exercises, the strength and power of the spinal extensor muscle is increased leading to decrease in pain and increased stability of the spinal column. There is an associated increased psychological well being associated with decrease in pain. In chronic low back pain patients the pain presents for a long time. This pain in turn may further limit activity that causes more muscle weakness (atrophy), which may be related to increased pain. This creates a cyclic effect. This lumbar extensors training may help break the atrophy-pain cycle[38].

I have chosen Core stabilization because; Core stabilization is rehabilitative, performance enhancing, injury prevention regimen and can be incorporated into any fitness program. It stress the movement in three-dimensional planes; Frontal, sagital and coronal plane. It strengthens the lumbopelvic comlex, which is a seat for Functional kinetic chain. It integrates the neuromuscular system as well as the musculo skeletal system. So it is superior to any other rehabilitative regimen.[16]

II. Aim Of The Study

To study the effectiveness of spinal extensor exercise versus core stabilization with combination of interferential therapy to improve chronic lo back pain patients.

III. Objectives Of The Study

- To find out the effectiveness of core stabilization and interferential therapy to reduce chronic low back pain
- To find out the effectiveness of spinal extension exercises and interferential therapy to reduce chronic low back pain
- To compare the effectiveness of core stabilization and interferential therapy versus spinal extension exercises and interferential therapy to reduce chronic low back pain.

IV. Methodology

Setting: -

1) Burdwan Medical Collage and Hospital, Burdwan.
2) Burdwan Institute of Medical and Life Science, Burdwan.

Duration of the study: 6 months.
Sample Size: 30 patients.
Research design: Randomized control trial
Sample selection:
Inclusion Criteria

1. Age – 40-50 years
2. Sex – (both) Male and females
3. Restriction of spinal mobility due to muscular spasm concluded by palpation.

Exclusion Criteria

1. Any tumours present in the spinal cord.
2. Any systemic disease like gastritis.
3. Muscle disease like myositis.
4. (IVDP) intervertebral disc prolapse
5. Any cardiac abnormality disease.
6. Spinal cord injury patients

Study Design: -

Randomised comparative study

Equipment and Materials Used:
1 Treatment Couch
2 Interferential Therapy unit
3 Electrode Gel
4 Cotton Swab
5 Two pair of leads with four rubber electrodes
6 Sufficient pillows and sheets
7 Swiss Ball
8 Velcro Strap
9 Mat
10 Skin Marker
11 Inch tape

Data Collection Procedure

The purpose of the study is to compare the effectiveness of the spinal extension exercise versus core stabilization exercises with common use of interferential therapy to decrease pain and to increase functional ability in chronic low back pain patients.

To full fill the purpose of the study the therapist adopted very careful and planned method from the selection of subjects, test administration, collection of data and the statistical procedure for analysing the data . In this study 30 patients were selected.

Selected Measures and Variables:
1) Pain – VAS scale
2) Range of Motion – Schobers Test
3) Functional Ability – Oswestry Disability Index.

Figure 1

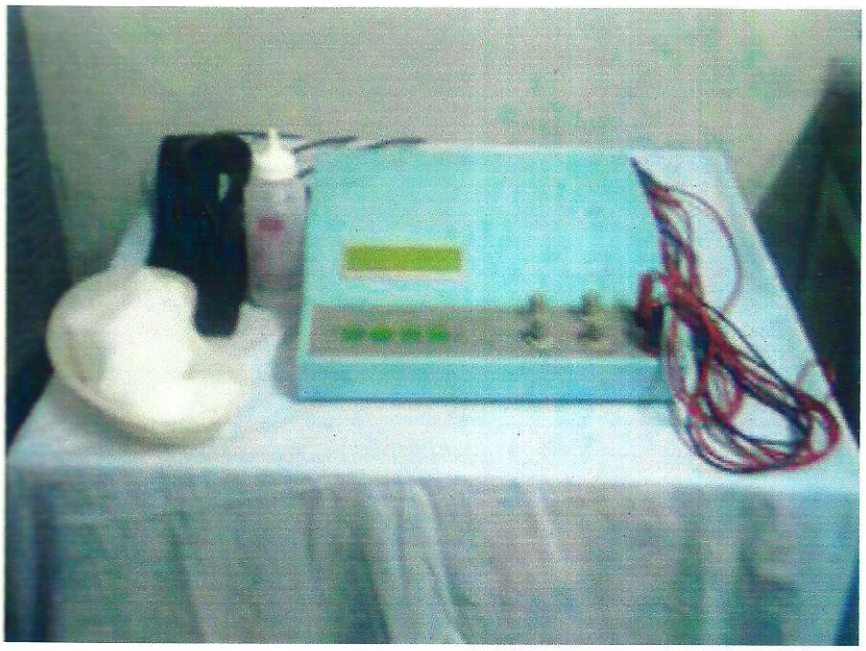


Figure 1 shows materials used for this study

Procedure: -

The informed consent of the patient is taken. Then the patients are selected according to the inclusion criteria. The patients who don't fit in the inclusion criteria are rejected. The initial assessment of the patients is performed; the detailed assessment chart is affixed in appendix no.1. An observer blinded to the study takes the

outcome measure of the study VAS score, ROM and Oswestry Disability Index. The patients are allocated into two groups. Both groups A and B and patients receive IFT for the first week. To give IFT, the patients is made to lie in prone lying position on the couch and treatment area is exposed by maintaining privacy of the patient. The area to be treated is cleaned with wet cotton swab to reduce the skin resistance, and the four-channel electrode placed on the area to be treated. The parameters chosen for treatment are a four Kilo Hz frequency, a 100 Hz sweep, 15 minutes duration and a program no. 11. The intensity of the IFT is adjusted according to the patients' tolerance. After treatment the area is cleaned with a cotton swab, proper wind up is done. This is continued for a period of seven days after which the exercise program started.

Group A: -

After IFT, core stabilization exercises are given for the next three weeks.

The exercise program for core stabilization group consists of prone and supine exercises, stabilization exercises and gym ball exercises.

Prone Exercises: -

The patient lies to prone lying position on the mat with hand stretched out in air and raises the trunk upward in extension. Advice given to do this exercise for 10 reps. Each repetitions is kept 10 seconds hold.

Figure 2

Figure 2 shows patient receiving IFT

Figure 3

Figure 3 shows patient doing bridging exercises on gym ball

Supine Exercises: -

In supine lying position on the mat, the patient tucks the tummy in i.e. draws the navel towards the spine. (This is known as abdominal hollowing.). Advise is given to do this exercise for 10 reps. Each repetition is kept for a 10 seconds hold.

Stabilization Exercise: -

It consists of curl up, side bridge and bird dog exercises.

Curl Up Exercise: -

Stabilization exercises starts with curl up. In order to perform this exercise the patient lies in crook lying position on the mat and then raises the trunk upwards with hands i.e., stretched up in the air forward or hands behind the back. Advise is given to do this exercise for 10 reps. Each repetition is kept for a 10 seconds hold.

Side Bridge Exercises: -

The side bridge exercise is performed on the mat by patient lying in side lying position. Start on your right side and press up with your right arm. From a bridge with your arm extended and hold for 10 seconds rather than performing 10 repetitions. Gradually build up like a pyramid like fashion.

4 reps for 10 second hold. (first right side and then left)
3 reps for 10 seconds hold. (first right side and then left)
2 reps for 10 seconds hold. (first right side and then left)

Bird Dog Exercise: -

The patient lying is quadruped prone position on the mat performs bird dog exercise. The patient first lifts one hand in the air. Then it is progressed to two point kneeling. The patient lifts one hand in the air and opposite leg in the air. This is repeated with the opposite leg and the hand. Advise is given to do this exercise for 10 reps. Each repetition is kept for a 10 seconds hold.

Bridging Exercises On A Gym Ball: -

Gym ball exercise is done to provide greater challenge to the muscle. The patient lies in supine lying position on the mat and then lift both legs on the ball, with hands besides the trunk. The patient then lifts the pelvis off the floor, with hands on the side of the trunk on the mat. The therapist supports the ball. The patient lies in supine lying position on the floor with hands on the side of the trunk. Repeat this exercise for 10 reps. Each repetition is kept a 5-10 second hold.

LEG PRESS EXERCISES: -

The patient lies in supine lying position on the mat and the therapist lifts both the legs of the patient and keeps them on the gym ball. The patient presses the gym ball with his legs. The Produce a strong contraction of back muscle. Hold this contraction for a 10 second hold. Perform this exercise for 10 repetition.

GROUP B: -

Group B patients receive additional to IFT, spinal extension exercises for another three weeks. The spinal extension exercises are as follows.

Exercise No. 1: -

This patient lies in prone lying position on the mat and lifts one leg in the air and then the opposite leg in the air. The patient holds each leg in the air for 5 to 10 seconds. This exercise is done 10 repetitions per set. Initially the patirnts perform only 2-3 sets and slowly it is increased to 10 sets.

Exercise No. 2: -

The patient lies in prone lying position on the mat and lifts both hands in the air and holds it for a period of 5 to 10 seconds hold. This exercise is done for 10 repetitions per set. Initially the patients perform only 1-2 sets and then slowly it is increased to 5 sets.

Exercise No. 3: -

This exercise is performed with the patient lying in prone lying position on the mat. The patient first lifts one hand in the air and then the opposite leg in the air. This maneuver is repeated with the opposite arm and

the leg. This exercise is done for 10 repetitions per set. Initially the patients perform 2-3 sets only and then slowly it is increased to 10 sets.

Figure 4

Figure 4 shows patient doing spinal extension exercises

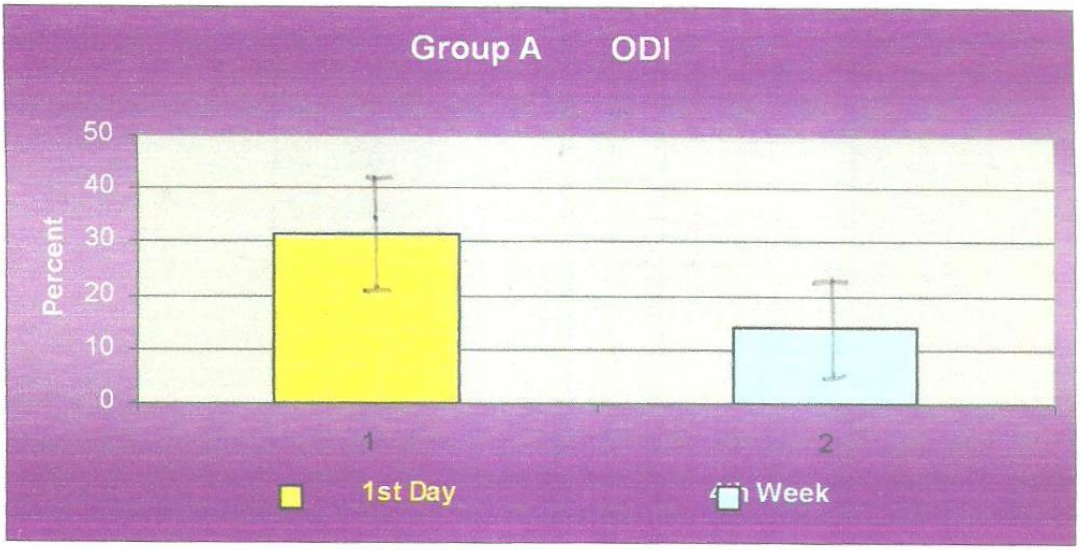
V. Results & Interpretation

Table – 1 ODI (Percent) scores within Group A between 1st day and 4th week.
Paired t-test

SL. NO.	ODI (Percent)	
	1st Day	4th Week
1	37.25	17.64
2	31.3	15.60
3	47.05	23.52
4	33.33	7.84
5	23.00	7.84
6	47.05	21.56
7	22	13.72
8	19.6	9.8
9	47.05	35.29
10	17.64	1.96
11	27.40	11.76
12	27.00	9.80
13	22.00	3.92
14	26.00	9.80
15	43.00	21.50
P – value	3.80547E- 09	
d.f	14	
MEAN	31.378	14.10333333

SD	**10.51412397**	**8.674357668**
MEAN +	**41.89212397**	**22.777691**
MEAN -	**20.86387603**	**5.428975665**

Null Hypothesis H_0: -There is no significant change in the ODI (%) score within Group – A between 1st day and 4th day.
Alternative Hypothesis H_1: - There is no significant change in the ODI (%) scores within Group – A between pre and post treatment group.
Interpretation: - Since P =3.80547 x 10^{-9}, which is less than 0.05, hence H_0 is rejected at 5% level of significance and this indicates that significant improvement occurs after 4 weeks of treatment by reducing the functional in chronic low back pain patients.

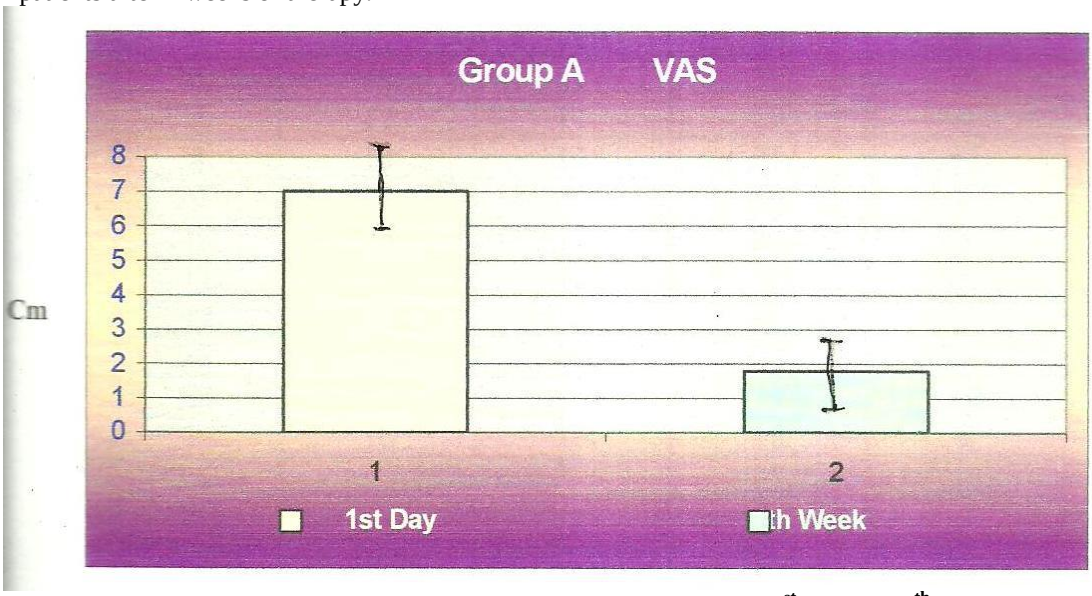


Graph – 1: ODI (percentage) scores within Group A between 1st day and 4th week which shows significant improvement after 4 weeks of CS therapy.

Table – 2 VAS Scores within Group A between 1st day and 4th week.
Paired t-test

SL. NO.	**VAS**	
	1st Day	**4th Week**
1	**8**	**2**
2	**8**	**2**
3	**7**	**3**
4	**5**	**1**
5	**6**	**2**
6	**7**	**2**
7	**8**	**3**
8	**7**	**1**
9	**8**	**4**
10	**5**	**0**
11	**8**	**3**
12	**7**	**1**
13	**6**	**0**
14	**7**	**1**
15	**8**	**2**
P – value	**$1.29274x10^{-12}$**	
d.f	**14**	
MEAN	**7**	**1.8**
SD	**1.069044968**	**1.146423008**
MEAN +	**8.069044968**	**2.946423008**
MEAN -	**5.930955032**	**0.653576992**

Null Hypothesis H_0: - There is no significant change in the VAS score within Group – A between 1st day and 4th weeks.
Alternative Hypothesis H_1: - There is significant change in VAS scores within Group – A between pre and post treatment group.
Interpretation: - Since P value is almost zero, H_0 is rejected and it is concluded that VAS scores reduce very significantly after 4 weeks of treatment in group – A patients. i.e. C.S. group shows significant improvement to such patients after 4 weeks of therapy.



Graph – 2 Vas scores in Group A patients (C.S. Therapy) between 1st day and 4th week. It shows significant improvement after 4 weeks of therapy.

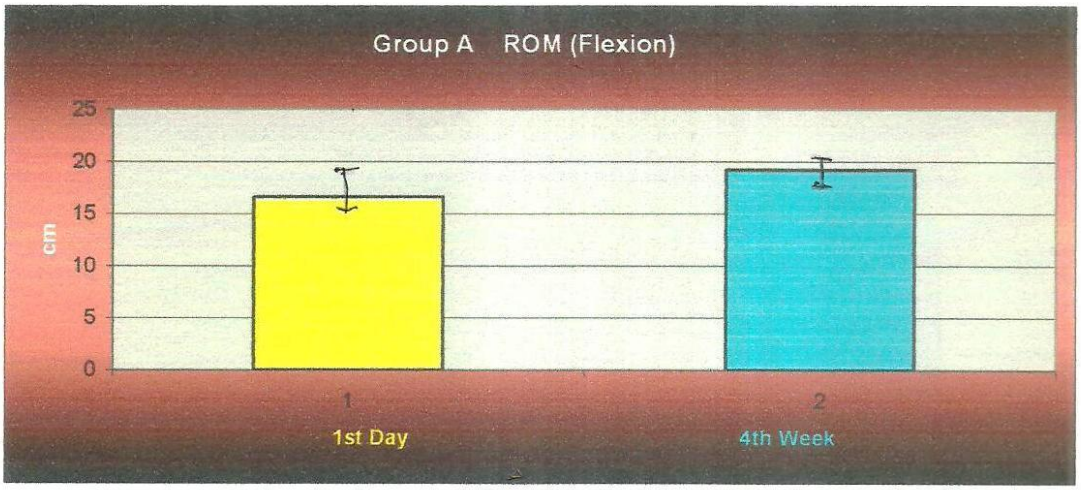
Table – 3 ROM Scores within Group A between 1st and 4th week. Paired t test

SL. NO.	ROM			
	1st Day		4th Week	
	Flex. (cm)	Ext. (cm)	Flex. (cm)	Ext. (cm)
1	17	10	19	8
2	17	11	19	9
3	18	9	20	8
4	17	9	19	7
5	15	10	17	8
6	18	11	20	9
7	17	11	19	9
8	18	13	21	10
9	17	9	19	7
10	15	11	20	9
11	17	10	19	8
12	16	9	19	7
13	16	10	20	8
14	15	12	19	10
15	16	10	18	8
P – value	7.15761×10^{-8}		7.72351×10^{-12}	
d.f	14		14	
MEAN	16.6	10.333333333	19.2	8.333333333
SD	1.055597326	1.175139303	0.941123948	0.975900073
MEAN +	17.65559733	11.50847264	20.14112395	9.309233406
MEAN -	15.54440267	9.158194031	18.25887605	7.35743326

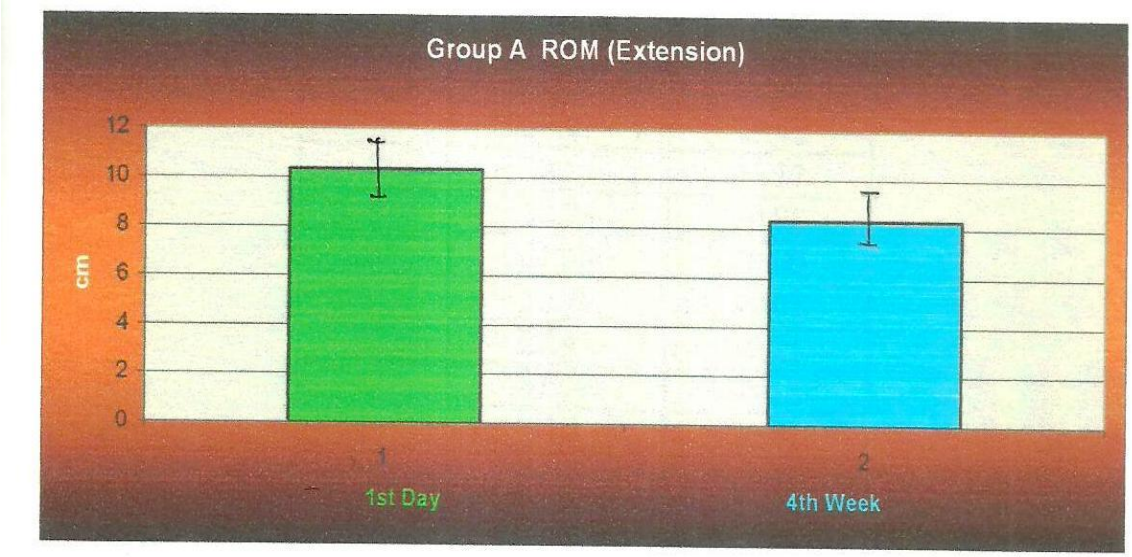
ROM (Flexion)
Null Hypothesis H_0: - There is no significant change in the Flexion score (cm.) within Group A patients after 4 weeks of treatment.

Alternative Hypothesis H_1: - Flexion score will improve in Group A patients after 4 weeks of treatment.
Interpretation: - Since P value is almost zero, H_0 is rejected and H_1 is accepted. This means that after 4 weeks of C.S. therapy in group – A; there is significant reduction in chronic low back pain.

ROM (Extension)
Null Hypothesis H_0: - There is no significant change in the Extension score (cm.) within Group A patients after 4 weeks of treatment.
Alternative Hypothesis H_1: - Extension score will reduce in Group A patients after 4 weeks of treatment.
Interpretation: - Since P value is zero, H_0 is rejected and thus H_1 is accepted, which shows significant reductions in ROM (Extension) score in group A after 4 weeks of therapy. This indicates that 4 weeks CS therapy significantly reduces pain and spasm of muscles in group A patients.



Graph – 3 ROM (Flexion) Scores in Group A patients (CS) Therapy between 1st day and 4th week. It shows significant improvement after 4 weeks of therapy.

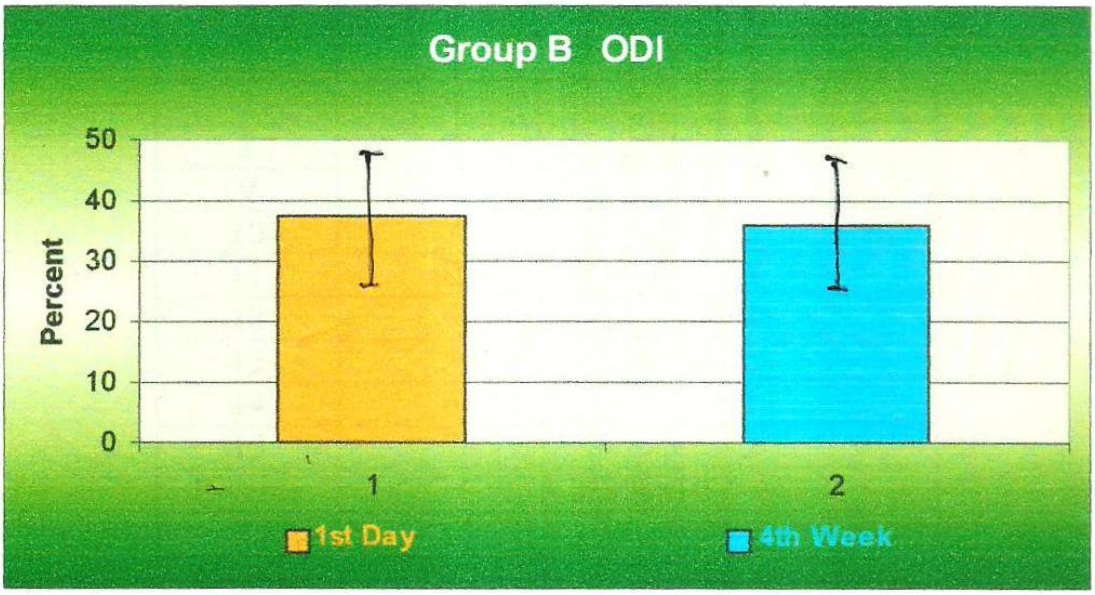


Graph – 4 ROM Extension Scores in Group A patients between 1st day and 4th week. It shows significant improvement in extension scores after 4 weeks of therapy.

Table – 4 ODI (Percent) scores within Group B between 1st day and 4th week.
Paired t-test

SL. NO.	ODI (Percent)	
	1st Day	4th Week
1	45.09	43.13
2	27.45	30.21
3	47.05	43.13
4	20.00	25.49
5	45.09	43.13
6	31.3	29.41
7	29.41	27.45
8	43.13	41.17
9	52.94	50.98
10	21.56	27.00
11	50.98	49.01
12	27.45	32.21
13	45.09	43.13
14	31.3	29.41
15	45.09	25.49
P – value	0.340936819	
d.f	14	
MEAN	37.52866667	36.02333333
SD	10.94822286	8.997999513
MEAN +	48.47688953	45.02133285
MEAN -	26.58044381	27.025333822

Null Hypothesis H_0: -There is no significant change in the ODI (%) score within Group – B between 1st day and 4th week.
Alternative Hypothesis H_1: - There significant change in the ODI (%) scores within Group – B between pre and post treatment group.
Interpretation: - Here P value = 0.341, it appears that H_0 is accepted and change in ODI (%) score in group – B patients after 4 weeks of S.E, therapy is insignificant.

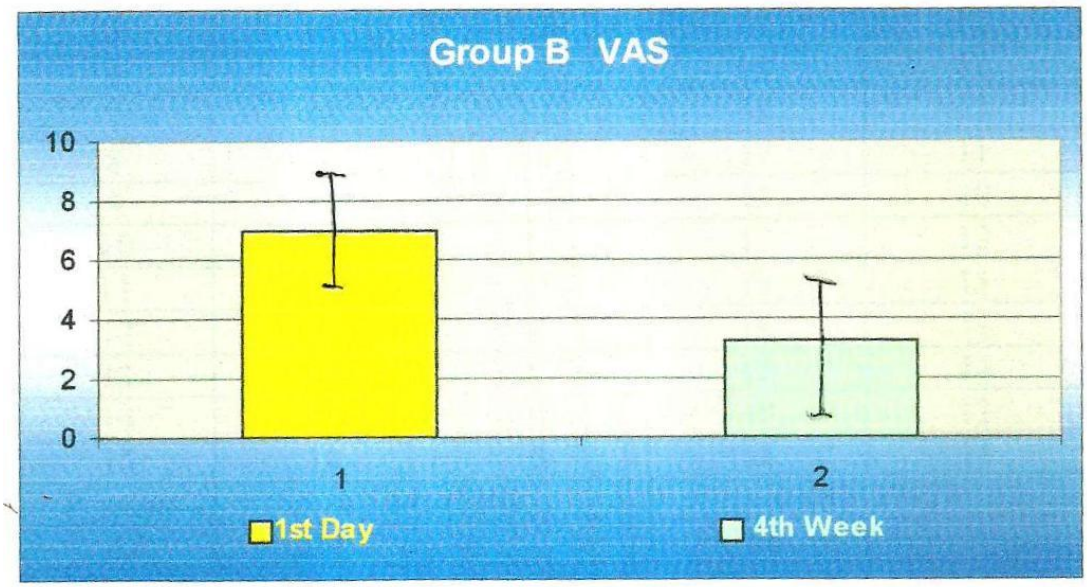


Graph – 5 ODI (percentage) scores within Group B between 1st day and 4th week which shows insignificant improvement after 4 weeks of therapy.

Table – 5 VAS Scores within Group B between 1st day and 4th week.
Paired t-test

SL. NO.	VAS	
	1st Day	4th Week
1	5	1
2	9	6
3	7	7
4	4	0
5	7	4
6	8	3
7	8	2
8	7	3
9	8	5
10	7	2
11	8	3
12	9	4
13	5	6
14	6	1
15	7	2
P – value	$3.17308x10^{-6}$	
d.f	14	
MEAN	7	3.266666667
SD	1.463850109	2.051712409
MEAN +	8.463850109	5.318379076
MEAN -	5.536149891	1.214954258

Null Hypothesis H_0: - There is no significant change in the VAS score within Group – B between 1st day and 4th weeks.
Alternative Hypothesis H_1: - There is significant change in VAS scores within Group – B between pre and post treatment group.
Interpretation: - Since P value is almost zero, H_0 is rejected and it may be concluded that S.E therapy after 4 weeks of treatment in group – B patients significantly increases the VAS scores which means that Chronic low back pain increases after 4 weeks of treatment and therefore S.E therapy for group B patients gives insignificant results, in other words, this therapy in group B patients should not be recommended.



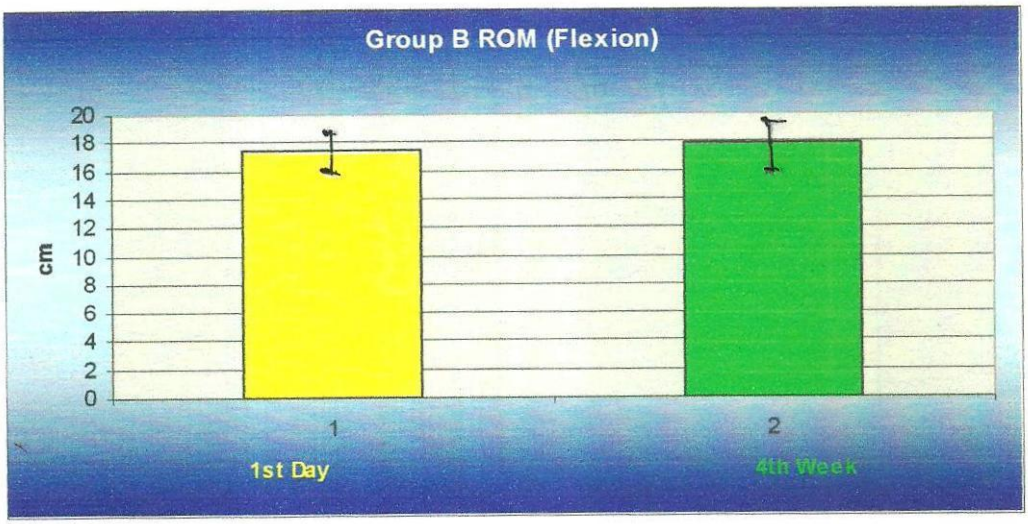
Graph – 6 VAS scores within Group B between 1st day and 4th week which shows significant improvement after 4 weeks of therapy.

Table – 6 ROM Scores within Group B between 1st and 4th week.
Paired t test

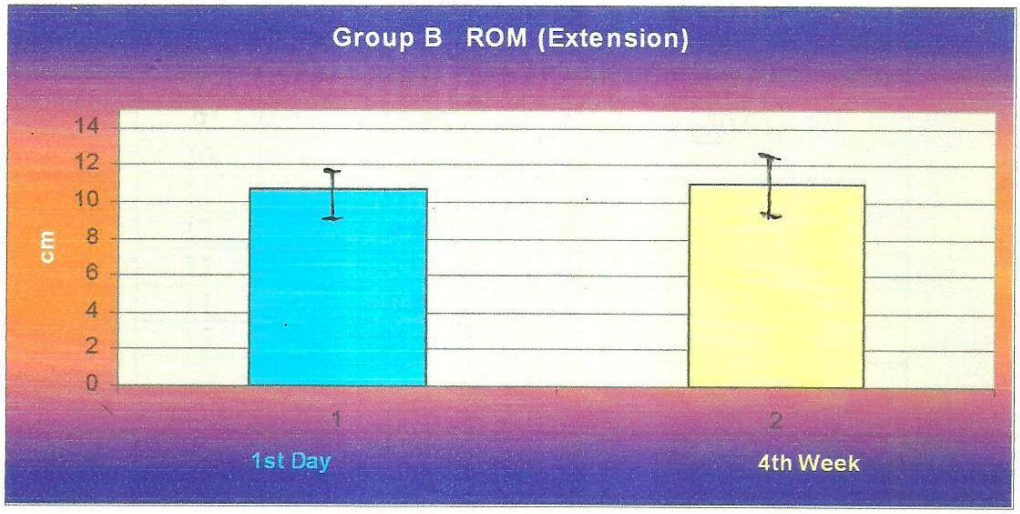
SL. NO.	ROM			
	1st Day		4th Week	
	Flex. (cm)	Ext. (cm)	Flex. (cm)	Ext. (cm)
1	19	11	20	12
2	17	10	16	11
3	19	10	19	10
4	18	9	20	8
5	18	12	17	12
6	17	11	19	12
7	18	13	18	13
8	17	10	17	11
9	14	10	13	10
10	17	11	17	12
11	18	11	19	11
12	17	10	18	11
13	19	11	19	11
14	17	12	19	11
15	18	9	18	11
P – value	0.164317898		0.082417877	
d.f	14		14	
MEAN	17.53333333	10.66666667	17.93333333	11.06666667
SD	1.245945806	1.112697281	1.79151439	1.162919151
MEAN +	18.77927914	11.77936395	19.72484772	12.22958582
MEAN -	16.28738753	9.553969386	16.14181894	9.903747515

ROM (Flexion)
Null Hypothesis H_0: - There is no change in the Flexion score (cm.) within Group B after 4 weeks of treatment.
Alternative Hypothesis H_1: - There is change in Flexion score in Group B patients after 4 weeks of treatment.
Interpretation: - Here P value = 0.164 which indicates that H_0 is accepted and thus S.E therapy does not yield any improvement in group B patients even after 4 weeks of treatment.

ROM (Extension)
Null Hypothesis H_0: - There is no change in Extension score (cm.) within Group B patients after 4 weeks of treatment.
Alternative Hypothesis H_1: - Extension score increase in Group B patients after 4 weeks of treatment.
Interpretation: - Here P value = 0.0824 > 0.05 thus H_0 is accepted at 5% level of significance which indicates that in group B (SE therapy) patients there is no improvement towards reduction in pain and spasms of patients.



Graph – 7 ROM (Flexion) Scores in Group A patients (SE) Therapy between 1st day and 4th week. It shows significant improvement in Flexion Scores after 4 weeks of therapy.



Graph – 8 ROM Extension Scores in Group B patients (SE Therapy) between 1st day and 4th week. It shows significant improvement in extension scores after 4 weeks of therapy.

Table – 7 ODI Scores between two Groups.

FISHER'S t-test

SL. NO.	ODI (Percent)	
	Group A (4th Weeks)	Group B (4th Weeks)
1	17.64	43.13
2	15.60	30.21
3	23.52	43.13
4	7.84	25.49
5	7.84	43.13
6	21.56	29.41
7	13.72	27.45
8	9.8	41.17
9	35.29	50.98
10	1.96	27.00
11	11.76	49.01
12	9.80	32.21

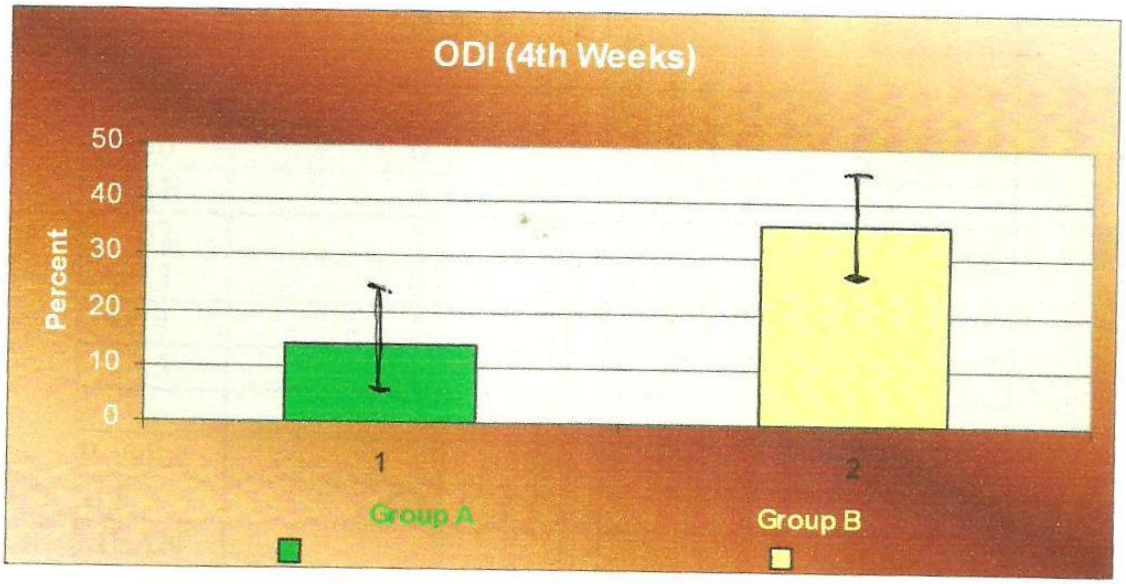
13	**3.92**	**43.13**
14	**9.80**	**29.41**
15	**21.50**	**25.49**
P – value	**$2.23167x10^{-7}$**	
d.f	**28**	
MEAN	**14.10333333**	**36.02333333**
SD	**8.674357668**	**8.997999513**
MEAN +	**22.777691**	**45.02133285**
MEAN -	**5.428975665**	**27.02533382**

FISHER'S t-test

Null Hypothesis H_0: -There is no change in the ODI (%) score within Group – A & B between after 4 weeks of treatment.

Alternative Hypothesis H_1: - ODI score for Group B patients is higher than those of Group B patients after 4 weeks of therapy.

Interpretation: - Since P value is almost zero, H_0 is rejected and H_1 is accepted, which mean that treatment with C.S. is significantly beneficial than spinal extension therapy.



Graph – 9 Shows ODI values of Group A and Group B after 4 weeks of therapy. After 4 weeks ODI Scores in Group A are significantly reduced.

Table – 8 VAS Scores between two Groups.

FISHER'S t-test

SL. NO.	VAS	
	Group A (4^{th} Weeks)	Group B (4^{th} Weeks)
1	**2**	**1**
2	**2**	**6**
3	**3**	**7**
4	**1**	**0**
5	**2**	**4**
6	**2**	**3**
7	**3**	**2**
8	**1**	**3**
9	**4**	**5**
10	**0**	**2**
11	**3**	**3**
12	**1**	**4**

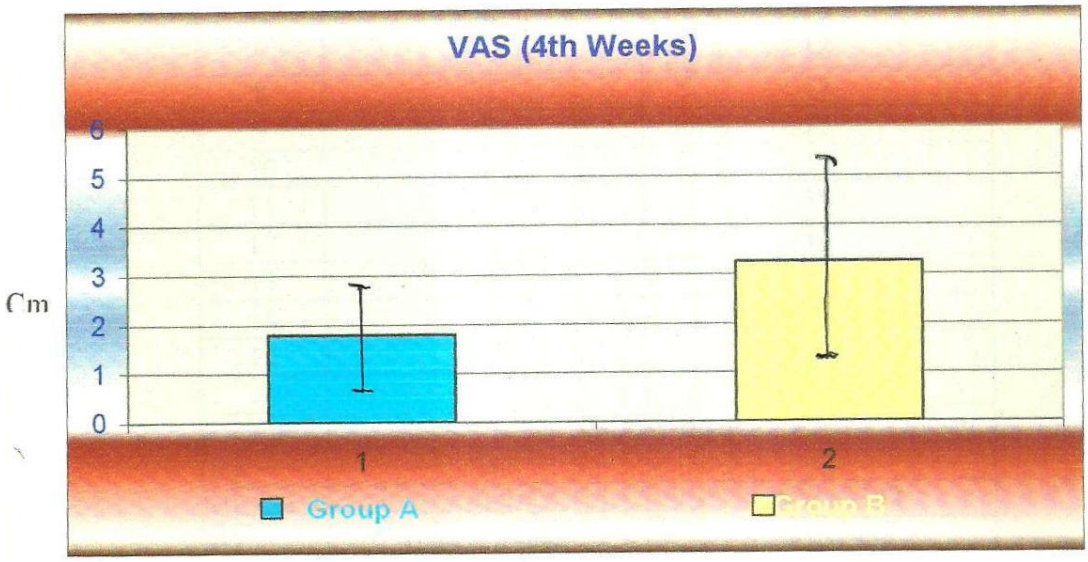
13	**0**	**6**
14	**1**	**1**
15	**2**	**2**
P – value	**0.02241799**	
d.f	**28**	
MEAN	**1.8**	**3.266666667**
SD	**1.146423008**	**2.051712409**
MEAN +	**2.946423008**	**5.318379076**
MEAN -	**0.653576992**	**1.214954258**

FISHER'S t-test

Null Hypothesis H_0: - There is no change in VAS score between two group of patients after 4 weeks of treatment.

Alternative Hypothesis H_1: - VAS score for Group B patients is increase than that of Group A patients after 4 weeks of therapy.

Interpretation: - Here P value = 0.022 thus H_0 is rejected at 5% level of significance which means that H_1 is true and it implies that C.S. therapy is more beneficial than S.E. therapy after 4 weeks.



Graph – 10 Shows VAS Scores of Group A and B after 4 weeks. After 4 weeks VAS Scores Group A are significantly reduced than in Group B.

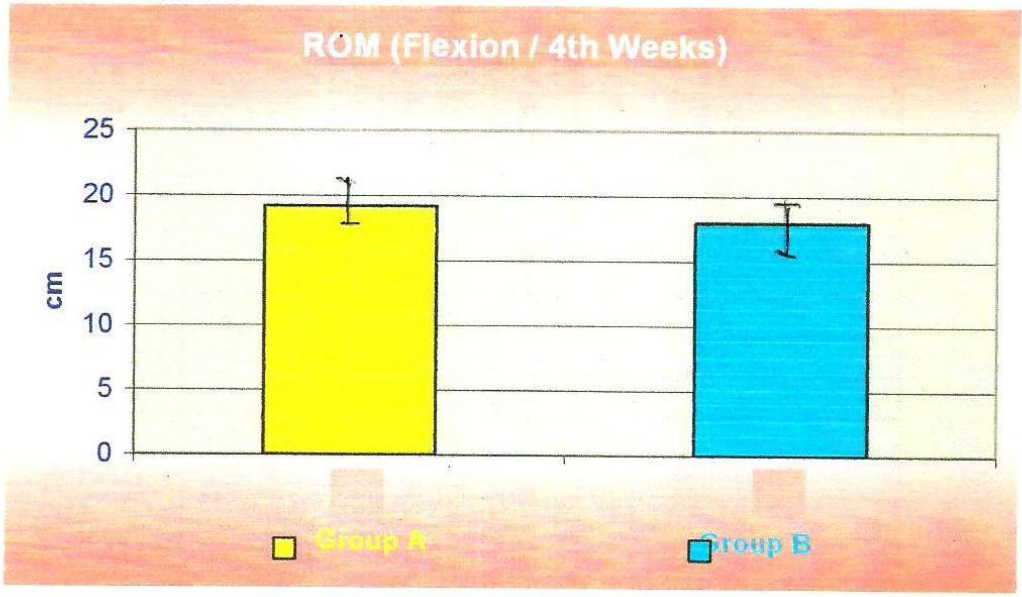
Table – 9 ROM (Flexion) Scores between two Groups.

FISHER'S t-test

SL. NO.	ROM (Flexion)	
	Group A (4^{th} Weeks)	Group B (4^{th} Weeks)
1	**19**	**20**
2	**19**	**16**
3	**20**	**19**
4	**19**	**20**
5	**17**	**17**
6	**20**	**19**
7	**19**	**18**
8	**21**	**17**
9	**19**	**13**
10	**20**	**17**
11	**19**	**19**
12	**19**	**18**
13	**20**	**19**

14	**19**	**19**
15	**18**	**18**
P – value	**0.022050536**	
d.f	**28**	
MEAN	**19.2**	**17.93333333**
SD	**0.941123948**	**1.79151439**
MEAN +	**20.14112395**	**19.72484772**
MEAN -	**18.25887605**	**16.14181894**

Null Hypothesis H_0: -There is no change in ROM flexion score between two groups after 4 weeks of therapy.
Alternative Hypothesis H_1: - There is reduction of flexion score in group B than in group A after 4 weeks of therapy.
Interpretation: - Since P value = 0.0221, H_0 is rejected at 5% level of significance ans obviously alternative hypothesis is accepted. Thus here also C.S. therapy claims better impact than S.E. therapy after 4 weeks of treatment.



Graph – 11 Shows ROM scores of flexion between Groups A and B after 4 weeks of therapy. Group A shows significant improvement in flexion scores than in Group B after 4 weeks.

Table – 10 ROM (Extension) Scores between two Groups.
FISHER'S t-test

SL. NO.	ROM (Extension)	
	Group A (4^{th} Weeks)	Group B (4^{th} Weeks)
1	**8**	**12**
2	**9**	**11**
3	**8**	**10**
4	**7**	**8**
5	**8**	**12**
6	**9**	**12**
7	**9**	**13**
8	**10**	**11**
9	**7**	**10**
10	**9**	**12**
11	**8**	**11**
12	**7**	**11**
13	**8**	**11**
14	**10**	**11**
15	**8**	**11**
P – value	**$1.3943x10^{-7}$**	

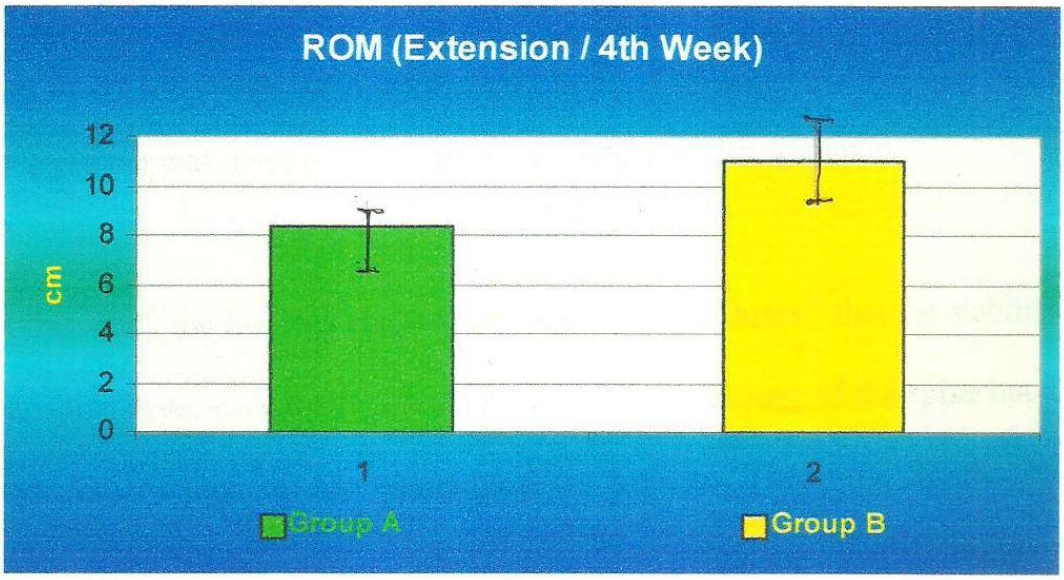
d.f	28	
MEAN	8.333333333	11.06666667
SD	0.975900073	1.162919151
MEAN +	9.309233406	12.22958582
MEAN -	7.35743326	9.903747515

FISHER'S t-test

Null Hypothesis H_0: -There is no change in ROM (extension) score between two group of after 4 weeks of treatment.

Alternative Hypothesis H_1: - ROM (extension) score increases in group B than in group A after 4 weeks of therapy.

Interpretation: - Since P value is almost zero, H_0 is rejected and H_1 is accepted. Thus on the basis of such-findings it can be concluded that C.S. therapy in group A is significantly better than S.E. therapy in group B for improvement in functional ability, reduction in pain for patients presenting chronic low back pain.



Graph – 12 Shows ROM scores of Extension between group A and B after 4 weeks. After 4 weeks ROM Extension has significantly reduced in group A than in B.

VI. Discussion

The result of this study support the initial hypothesis that core stabilization exercises is effective in reducing pain, functional disability and improve ROM in chronic low back pain patients. Analysis of pain and functional disability and ROM showed that scores in the core stabilization group showed significant differences compared to the spinal extensors exercises group after the treatment of 4 weeks. Mean VAS score in A=1.8, Mean VAS score in B=3.27 P< 0.05. The core stabilization treatment approach was more effective than the spinal extensor group.

In this study the findings support the Punjabi's hypothesis[34] that the stability of the lumbar spine is dependent not solely on the basic morphology of the spine but also
the correct functional of the neuromuscular system. Therefore, if the basic morphology of the lumbar spine is compromised, or in the case with symptomatic spondylolysis and spondylolisthesis, the neuromuscular system may be trained to compensate, to provide dynamic stability to the spine during the demands of daily living.

In this study the subjects mainly had SI joint dysfunction in females due to trauma occurring to the soft tissues during pregnancy, spondylosis, spondylolisthesis and other lumbar spine dysfunction like spinal instability and facet joint pathology.

One remarkable finding of the study was that after four weeks of treatment there was a significant reduction in functional disability. The core stabilization group reported a reduced need for medications after one week of follow up. Many specific exercise group reported that there is no longer needed to perform the formal

exercises they had been taught, but simply continued to co activate the muscle during functional activities of daily living.

IFT results were markedly better than ever expected. There was significant reduction in pain in both the groups. Although there is enough evidence to support its efficacy, Group A showed more reduction in pain than group B. Patients whose VAS score was 8 on day one reduced to 3 on 4th day itself.

Spinal Extension exercises did not show results significant enough than the Core Stabilization group. There was no significant change in ROM and functional disability in group B patients. Although there was obvious centralization signs visible, the results were not satisfactory enough to give significant results.

The finding of this study support that a change in the motor program had occurred in the specific exercise group after the intervention, such that automatic pattern of recruitment of abdominals to stabilize the spine during a motor task incorporated higher levels of deep abdominal muscle activity. These represent an enhanced ability, in those in the specific exercise group, to stabilize dynamically their spine during functional tasks.

A challenge for future research will be to further investigate the potential of this form of exercise intervention to alter automatic patterns of muscle recruitment within the trunk musculature in pain population. However, the lack of changes in spinal extensor group during one month period indicates that the natural outcome for their chronically symptomatic population using other forms of conservative intervention is not positive. Future research is needed to assess the efficacy of their form of intervention in other CLBP populations where anatomic of the lumbar spine has been compromised.

VII. Conclusion

The findings of this trial support the view that the functional integration of specific exercises directed at the deep abdominal muscles and lumbar multifidus muscles are effective in reducing pain and functional disability in patients with chronic low back pain. This supports Punjabi's hypothesis, that spinal stability is dependent on interplay between the passive, active, and neural control systems. Accordingly, where the stability of the basis morphology of the lumbar spine is compromised (such as with spondylolysis and spondylolisthesis), specific training of the muscles considered to provide dynamic stability to the lumbar spine may act to maintain neutral zones of motion segment within more limits during functional activity.

In addition, the results of their study indicate that a "specific exercise" treatment approach directed at specific muscles is more effective than other conservative treatment approaches commonly used in patients with this condition. This intervention may provide a significant and viable alternative treatment approach in a patient population where such pathology is commonly treated with surgical fusion. Finally, this treatment approach may also have implications for wider LBP population when "instability of lumbar spine is suspected".

This study provides one step forward in the knowledge concerning the efficacy of exercise program to strengthen the Core Stability system. The results seem to indicate that the CSEP has an ability to strengthen the core muscles, especially TRA, and could provide an application to aid rehabilitation of LBP individuals.

References

[1]. Lucy Jane Goldby, Ann P. Moore, Jo Dust and Marion E. Randomized controlled trial investigating the efficiency of musculoskeletal physiotherapy on chronic low back disorders. Spine, Volume 31, Number 10, pp. 1083-1093.
[2]. RIE Kasai, RPT, MA Current trends in Exercise management for chronic low back pain. Comparison between strengthening Exercise and spinal segmental stabilization exercises. J. Phys. Ther. Sci. 18: 97-105, 2006.
[3]. Jeremy S. Lewis, Jane S. Hewitt, Lisa Billington. A randomized clinical trial comparing two physiotherapy interventions for chronic low back pain. Spine 2005, Volume 30, pp. 711-721.
[4]. Carter J, Birrell L. Occupation health guideline for the management of low back pain at work principal recommendations. London : Faculty of Occupational Medicine, 2000.
[5]. Hest back L, Lebaeuf-Yde C, Manniche C. Low back pain : what is the long term course? A review of studies of general patient population. Eur spine J 2003: 12: 149-65.
[6]. Zambito A, Bianchini D, Gatti D. Interferential therapy and horizontal therapies in chronic low back pain : a randomized double blind, clinical study. Cli Ex Rheumatol 2006, Sep- Oct, 24(5) : 534-9.
[7]. Hodges, P.W. and C.A.Richardson, Delayed postural contraction of transverse abdominis in low back pain associated with movement of te lower limb. J Spinal Disord, 1998. 11(1) : p-46-56.
[8]. Freeman, M.A., M.R. Dean and I.W. Hanham, The etiology and prevention of functional instability of the foot. J Bone Joint Surg Br, 1965.47(4):p.678-85.
[9]. Venu Akuthota, S.F. Nadler . Core strengthening Arch Phys Med Rehabil 2004, 85 (3 Supp. 1) : S86-92.
[10]. Newton M.A., Core stabilization, Core coordinator 2004 Aline Newton M.A. Advanced Certified Rolfer.
[11]. Peter B, Phyty, Dip Mandip Grad, Twomey Lance T. O'Sullivan. Evaluation of specific stabilizing exercise in treatment of spondylolysis or spondylolisthisis. Spine Vol. 22 (24). December 15, 1997.
[12]. Hides J.A. et al., Multifidus muscle recovery is not automatic after resolution of acute, first episode low back pain. Spine 1996;21:2763-9.
[13]. Lyons K, Perry J, Gronley JK, Barner L, Antonelli D. Timing and relative intensity of hip extensor and abductor muscle action during level and stair ambulation. An Emg. Study. Phys Ther 1983; 63:1597-806.

[14]. Devita P, Hunter PB, Skely W.A. Effects of a functional knee brace on the biomechanics of running. Med Sci Sports Exerc 1992; 24: 797-806.
[15]. Nadler Sf, Malanga GA, Feinberg JH, Prybicien M, Stitik TP, Deprince M. Relationship between hip muscle imbalance and occurrence of low back pain in collegiate athletes : a prospective study. Am J Phys Med Rehabil 2001; 80 : 572-7.
[16]. Barr, Karen P. MD; Griggr, Miriam MD. Lumbar Stabilization : Core Concepts and Current literature, Part-1, American Journal of Physical Medicine & Rehabilitation. 84(6): 473-486, June 2005.
[17]. Niemisto, Lema MD, Lahtinen – Suopanki, Tuna PT. Randomized trial of combined Manipulation, stabilization Exercises, and Physician consulation, and compared to physician consultant Alone for chronic low back pain. Spine 28 (19) : 2185-2191, October 1, 2003.
[18]. Suni, jaana PT, Phd; Rexine, Marjo PT, MSci; Control of the lumbar neutral zone decreases low back pain and improves self-evaluated work ability : A 12-month Rand omized controlled study. Spine- 31 (18) : E611-E620, August 15,2006.
[19]. Bakhiary,A.H.,Safavi-Farobhi, Z., Rezasoltani. A. (2005). Lumbar stabilization exercises improve activities of daily living in patients with lumbar disc herniation. The Journal of Back and musculoskeletal Rehabilitation, 18, 55-60.
[20]. Cook, C., Cook, A., Fleming, R.(2004). Rehabilitation of clinical lumbar instability in a female adolescent competitive diver with spondylisthisis. The Journal of manual and manipulative therapy, 12, 91-99.
[21]. Standford, ME (2000). Effectiveness of specific lumbar stabilization exercises; a single case study. Journal of Back and Musculokeletal Rehabilitation. 10; 40-46.
[22]. Shaughnessy, M. 1; Caulfield, B 2. A pilot study to investigate the effect of lumbar stabilization exercise training on function ability and quality of life in patients with chronic low back pain. International Journal of Rehabilitation Research. 27(4): 297-307, December 2004.
[23]. Daniel, R (2000). Effect of Practice on the ability to perform lumbar stabilization exercises, Journal of Orthopaedic and sports Physical therapy, 80, 202.
[24]. Scott F. Nadler, Malanga, Gerard A, Bartoli, Hip muscle imbalance and low back pain in athletes; influence of core strengthening. Medicine and Science in Sport and Exercise. 24(1): 9-16, January 2002.
[25]. Quittan M. Management of Bank pain. Disabil Rehabil. 2002 May 20; 24(8): 423-34.
[26]. Carpenter, David M; Nelson, Brion W. Low back strengthening for the prevention and treatment of low back pain. Medicine Science in sport and Exercises. 31(1) : 18-24, January 1999.
[27]. Hurley DA, Minder PM, MC Donough SM, Walsh DM. Interferrential therapy wlwctrode placement technique in acute low back pain; a preliminary investigation. Arch Phys. Med. Rehabil. 2001. Apr, 81(4): 485-93.
[28]. Rittweger J, Just K, Kautzsch K, Reeg P, Treatment of chronic lower back pain with lumbar extension and whole body vibration exercise; a randomized controlled trial Spine : 2002 sep 7; 27 (17): 1829-34.
[29]. Lauise Gagnon. Interferential therapy proves effective for low back pain. 4th inter disciplining world congress on low back and pelvic pain, in Motreal, Quebec, Canada 2001.
[30]. Narihiko Handa, Hiroshi Yamamoto, Toshikazu Tani, Teruhibo Kawabani. The effect of trunk muscle exercises in patients over 40 years of age with chronic low back pain. Journal of Orthopaedic Science.
[31]. McGill SM, Sharratt MT, Seguin JP, Loads on spinal tissues during simulataneous lifting and ventilator challenge. Ergonomics 1995; 38: 1772-92.
[32]. Michael E. Geisser, Ph.D. Elizabeth A. Wiggest, P.T., Andrew Y. Haig, M.d. and Miler O. A randomized, Controlled trial of manual therapy and specific adjuvant exercise for low back pain. Clin J. Pain – 2005; 21(6): 463-470
[33]. Gregory J lehman, Wajid Hoda and Steven Oliver-Trunk muscle activity during bridging exercises on and off a swiss ball. Chiropractice and Osteopathy 2005, 13: 14.
[34]. Panjabi MM. Clinical spinal instability and low back pain. J Electromyogr Kinesiol 2003; 13: 371-9.
[35]. Natasa Kavcic, M.Sc., Sylvian Grenier, Ph.D. and stuart M. McGill, Ph.D. Quantifying Tissue loads and spine stability while performing commonly prescribed low back stabilization exercise. Spine volume 29, Number 20, pp.2319-2329.
[36]. Kevin P. Granata, Ph.D. and Scott A. England, MS Stability of dynamic Trunk movement. Spine 2006, May 1; 31(10): E271-E276.
[37]. H. Frost, JA Klaber Moffett, JS Maser, JCT Fairbank. Randomized controlled trial for evaluation of fitness programme for patients with chronic low back pain. BMJ 1995; 310: 151-154. (21 january).
[38]. Sherry V. Risch, Ph.D. Nancy K. Norvell, Ph.D., Michael L. Pollock, Ph.D., Edward D. Risch, MD. Lumbar strengthening in chronic low back pain patients. Physiologic and psychological benefits. Spine Volume 18, No. 2, February 1993.
[39]. Farfan HF, Cossette JW, Robertson GH, Wells RV, Kraus H. The effects of torsion on the lumbar intervertebal joints: the role of torsion in the production of disc degeneration. J Bone Joint Surg Am 1970; 52: 468-97.
[40]. Valerice Gladwell, Samantha head, Martui Haggar, and Ralph Benebe. Does a program of Pilates improve chronic non-specific low back pain. J. Sports Rehabil. 2006, 15,338-350.
[41]. Jeremy Fairbank, Helen Frost, James Wilson, MacDonald, Randomized controlled trial surgical stabilization of the lumbar spine with an intensive rehabilitation programme for patients with chronic low back pain. BMJ 2005; 330: 1233(28 May).
[42]. Joseph M Hart, Julie M Fritz, D Casey Kerrigan, Ethan N Saliba. Reduced quadriceps activation after lumbar paraspinal fatifuing exercise.
[43]. Sai-Wing lee Ph.D, Climent Kin-ming chan, M.Sc. Tat sang lam, B.Sc. Ching lam Chronic Low Back Pain and lumbar multifidus size at different postures, Spine, Vol.31, NO.19.
[44]. Hides J, Jull G. And Richardson C (2001). Long term effects of specific stabilizing exercises for first episods low back pain. Spine 11: E243-E28. (2001).
[45]. Monica Millis dotter, Bjorn Stromqvist. Early neuromuscular customized training after surgey for lumbar disc herniation: a prospective controlled study. Eur Spine J (2007) 16: 19-26.
[46]. Rocha RCG, Robert Nee, Hall T, Chopard R (2006): Treatment of persistent knee pain associated with lumbar dysfunction. A case report. New Zealand Journal of Physiotherapy 34(1): 30-34.
[47]. Hides JA, Richardson CA, Jull GA and Davies SE. Ultrasound imaging in rehabilitation. Australian Journal of Physiotherapy 41: 187-193.
[48]. Wohlfahrt DA, Jull GA and Richardson CA: The relationship between the dynamic and static function of abdominal muscle. Australian Journal of Physiotherapy 39: 9-13.
[49]. Jull GA, Richardson, C, Toppenberg R, Comerford M and Bui B; Towards a measurement of active muscle control of lumbar stabilization. Australian Journal of Physiotherapy 39:187-193.
[50]. Twomey LT and Taylor JR: The lumbar spine: structure, function, age changes and physiotherapy. Australian Journal of physiotherapy 40th Jubliee Issue 1994:19-30.

[51]. Nick Kofotolis and Eleftherios Kellis: Effects of two 4-week proprioceptive Neuromuscular Facilitation Programs on Muscle Endurance, Flexibility, and Functional Performance in Women With Chronic Low Back Pain: PHYS THER Vol.86, No. 7, pp.1001-1012.
[52]. B rain W Nelson,. MD, David M Carpenter, MS, Thomas E. Dreisinger. : Can Spinal Surgery Be Prevented by Aggressive Strengthening Exercise? A prospective Study of Cervical and lumbar Patients.
[53]. Adams MA, Dolan P, Hutton WC. Diurnal variations in the stresses on the lumbar spine. Spine 1987; 12:130-7.
[54]. C.A Richardson, G.A. Jull. Concepts of assessment and rehabilitation for active Lumbar Stability. GRIEVES Modern Manual Therapy for vertebral column. 2nd Edition. Pp705-720.
[55]. David J. Maggee. Oswestry Disability Index. Orthopedics physical assessment. 4th Edition, pp -505.
[56]. David J. Maggee. Schobers test, Orthopedics physical assessment. 4t Edition, pp-526.
[57]. Paul W. Hodges, B Phty (Hons), Ph. D. Core stability exercise in chronic low back pain. Orthop clin N Am 34, pp 245-254.
[58]. Moseley L(2002). Combind Physiotherapy and education is efficacious for chronic low back pain. Australian Journal of Physiotherapy, 48:297-302.
[59]. Grilchrist R.V., Frey M.E., Nadler S.F (July, 2003). Muscular control of the lumbar spine. Pain Physician Journal. 6(3): 361-8.
[60]. Maratha Cullaty, M.P.T., M.E.D (summer, 2006). Suspected Sacroiliac Joint Dysjunction: Modifying Examination and Intervention During Pregnancy. Journal of Women's Health Physical Therapy, 30:2.
[61]. Schellenberg K.L, Lang J.M., Chan k M., Burnhan Endurance: Prone and Supine Bridge Maneuvers. Am. J. Phys. Med. Rehabil.
[62]. Jerrold S. Petrojsky (Ph.D), Maria Cuneo, Russell Dial, Amy Morris.(2005). Core muscle strengthening on a Portable abdominal Machine. The Journal of Applied Research Vol. 5, No. 3.
[63]. Lee Herringtion, Rachel Davis(2005). The influence of Pilates training on the ability to contract the Transversus Abdominis muscle in asymptomatic individuals. Journal of Body Works and Movement Therapies, 9, 52-57.
[64]. Alexis Ortiz, Sharon Olson, Charles L. Libby(summer, 2006). Core stability for the female Athlete: A Review Journal of Women's Health Physical Therapy; 30:2.
[65]. Luciana A.C. Machado, Chris G. Maher, Rob D. Herbert, Helen Clare(2005). The Mckenzie method for the management of acute non specific low back pain: design of a randomised controlled trial. BMC Musculoskeletal Disorders, 6:50.
[66]. Max Zusman. (1986) The Absolute Visual Analogue Scale (AVAS) as a measure of pain intensity. The Australian Journal of Physiotherapy, Vol.32; No.4.
[67]. Norris, C., (2001) Functional load abdominal training: Part-1. Physical Therapy in sport 2, 29-39.
[68]. O'sullivan, P., Twomey, L., Allision, G., (1998) Altered abdominal muscle recruitment pattern in patients with chronic back pain following a spwcific exercise intervention.
[69]. Koes, B., Bonter, L., Beckerman, H., Van Der Heijden, G., Knipschild, P.,(1991). Physiotherapy Exercises and back pain: a blinded review. British Medical Journal 302, 1572-1576.
[70]. Miller MI, Medeiros J.M (1987) Recruitment of internal oblique and transverse abdomens muscles during the eccentric phase of the curl-up exercise. Phys Ther. 67: 1213-1217.
[71]. Youdas J.W., Garrett T.R., Harmsen S., et. Al.(1996) Lumbar Lordosis and pelvic inclination of asymptomatic adults. Phys Ther. 76: 1066-1081.
[72]. Craig Steventon, Grabriel Nag. (1995) Effects of trunk flexion speed on flexion relaxation of erector spinae. Australian journal of Physiotherapy. Vol.-41: No.4 pp 241-243.
[73]. Tania L. Fontana, Carolyn A Richardson and Warren R. Stanton (2005). The effect of weight bearing exercise with low frequency, whole body vibration on lumbo sacral proprioception: A Pilot study on normal subjects. Australian Journal of Physiotherapy. Vol-51.
[74]. Helen A Clare, Roger Adams and Cghristopher G. Maher (2003). A systematic review of efficacy of Mckenzie therapy for spinal pain. Australian Journal of Physiotherapy: Vol-50: 209-216.
[75]. Mark Laslett, Sharon B. Young, Charles N. Aprill and Barry McDonanld (20030. Diagnosing painful sacroiliac joints. A validity study of a McKenzie evaluation and sacroiliac provocation test. Australian Journal of Physiotherapy, Vol-49.