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Comparison of Progressive Core Stabalization Exercises Versus General Core Exercises on Core Endurance in Individuals with Grade 1 Obesity: A Pilot Study

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Abstract
Obesity meaning the accumulation of fat in adipose tissue, is playing a major risk factor in mortality in people, especially females. In the majority of obese females, accumulation of fat is seen in the abdominal area, leading to poor endurance, reduced body stability and mainly stressing of the spine causing spine-related issues. This study focuses on two exercise regimens namely, progressive core exercises and core stabilization exercises on grade 1 obese women. The study included 48 females, of age 18 to 30 years, which were divided into 2 groups (Group A: general core exercises) and (Group B: progressive core exercises). The protocol was conducted for 6 weeks, pre and post-measures of BMI and McGill's endurance test were taken, inter-group parameters were assessed using the Mann-Whitney U test and intra-group were assessed using Wilcoxon's signed rank test. The study showed significant improvement between groups whereas no significant difference was found within Group A. We found highly significant improvement between group parameters of BMI and McGill's endurance test. Hence, administrating a progressive core exercise protocol is beneficial for improving core endurance and the quality of lifestyle of females.

Keywords: obesity, core endurance, core stabilization, McGill's core endurance test.

1. Introduction

Core muscles or the powerhouse is the engine for to smooth functioning of our body. (1) There are two groups of core muscles in our body, local and global muscles. Its differentiation was suggested by the Queensland research group to the postural segmental control and as multi-segmental stabilization group, respectively. Physiologically, Venu Akhota(2) has differentiated these groups by slow twitch as the local muscle system (deep layer) and fast twitch as the global muscle system (superficial layer). Panjabi's model of core mechanism works on 3 subsystems, namely, passive comprising static tissues, active comprising core muscle, and neural comprising nerves and signal transfer. The passive subsystem works as a natural belt providing proprioception, flexibility, and support to the lumbar spine and abdomen. The active subsystem consisting of paraspinal namely, erector spinae, multifidi, and quadratus lumborum work as a

major dynamic stabilizer for the spine. [3]

While training the core, one needs to utilize all local and global muscles. This is achieved using 3 basic principles, i. low threshold exercises focus on motor control stability; ii. High threshold training provides core strength and overload training provides core stability and hypertrophy.[4] Endurance signifies low load and high frequency whereas strength signifies high load and low frequencies. Thus for a stronger and higher endurance core, one needs to recruit both local and global muscle, using both high and low-load training and implying the overload principle.[5]

Core endurance is defined as sustaining low-level contraction to support and stabilize the spine. John Mayer correlated that 1point gain in body fat percentage, core endurance decreases by 4.4 seconds, whereas 1point gain in fat mass, core muscle endurance drops by 3.7 seconds, stating a direct relationship between core endurance, body fat percentage, and fat mass.[9] With recent prevalence studies about obesity and gender, it was concluded that abdominal obesity is 22.8% in males and 29.9% in females.[6] A study by Amit Kumar supported that poor core muscle function hampers body stability which can then lead to stressing the spine resulting in lower back pain and other injuries.[7]

Previous studies conducted by Alexis Anderson[8] and McGill[11], it showed that testing core endurance is more beneficial and practical than testing core strength. Hence, McGill's endurance test was chosen for this study, as it requires nominal equipment's, is economical, simple safer for execution and evaluation. The tests include isometric trunk endurance tests, namely, Biering—Sørensen test, 60^0 flexion test, and side bridge test. All tests have good reliability and validity.

In past research, progressive core exercises have been performed on athletes and the geriatric population but never in obese females. Hence, this study was performed to evaluate and compare the effects of progressive core exercises v/s core stabilization exercises on core endurance in females with grade 1 obesity.[10]

2. Methodology

Ethical clearance was obtained from the Institutional Ethical Committee of MAEER's Physiotherapy College, Talegaon Dabhade before commencement of the study. The study population consisted of females of obesity grade 1. The inclusion criteria was females within age limit: 18-30 years, BMI: Obese grade 1 (30-34.9), waist hip ratio: < 0.8 (females) , Scored as poor endurance levels at McGill test: flexion: extension ratio- >1.0; Right-side bridge: left-side bridge- >0.05; Side bridge (each side) : extension-> 0.75 and Nulliparous. The females with recent abdominal/ spinal surgery, recent trauma before 6 months, neurological/ cardio-vascular diseases, individuals performing regular exercise or any physical training and symptomatic or diagnosed back related conditions were excluded from the study.

The study was a comparative study with a duration of 12 months, 24 females were participated in the study. They were divided in two groups (12 in each group) who were in grade 1 obesity, using simple random sampling. The study protocol was approved by the ethics committee of MAEER's Physiotherapy College, Talegaon Dabhade. Participants

were recruited from public setting. Convenient sampling was done and females with grade 1 obesity with BMI higher than 30 to 34.9 and poor core endurance graded on McGill's core endurance test were included in the study. The participants were divided into 2 groups, Group A (12) were given progressive core exercises and Group B (12) was given general core exercises for 3 times per week for 6 weeks. Materials required for the study included a mat, plinth, stopwatch, paper, measuring tape, weighing machine, thera-ball, and resistance band. Eligible participants were educated about the condition, briefed and counselled

about the study. Written consent was taken from the patients those who were willing to participate in the study.

After giving their Informed consent to the study the participants the protocol started, the exercises in Group A included dead bug, partial sit-up, bridging, prone extension, quadruped, wall slides and lunges and stability ball exercises, while Group B participants were given drawing maneuver, sit-ups, bridging, crunches, bridging, hell slides with TA activation. The protocol was given for 3 times a week for 6 weeks. Warm up and cool down of 10 min each were incorporated in both groups making each groups exercise regimen of 30-45 minutes. The aim of the study was to determine the effect of progressive core exercises and general core exercises on core endurance and BMI at the end of 6 weeks. Pre and post measures of BMI and McGill endurance (all 3 tests) were taken at the beginning and of 6-week protocol.

The effectiveness of the protocols was determined by changes in the primary outcome measures from the baseline to the sixth week. Later the data was sent for statistical analysis.

3. Result

The inter-group statistical comparison of means of continuous variables is done using Mann-Whitney U test. The intra-group statistical comparison of means of continuous variables is done using Wilcoxon's signed rank test. The underlying normality assumption was tested before subjecting the study variables to non-parametric tests such as Mann-Whitney U test and Wilcoxon's signed rank test. All results are shown in tabular as well as graphical format to visualize the statistically significant difference more clearly.

In the entire study, the p-values less than 0.05 are considered to be statistically significant. All the hypotheses were formulated using two tailed alternatives against each null hypothesis (hypothesis of no difference). The entire data is statistically analyzed using Statistical Package for Social Sciences (SPSS ver 22.0, IBM Corporation, USA) for MS Windows.

Distribution of mean BMI between two study groups

The mean ± SD of BMI of cases studied in Group A [Experimental] and Group B [Control] was 31.85 ± 1.28 kg/m^2 and 31.72 ± 1.14 kg/m^2 respectively. The minimum – maximum BMI range in Group A and Group B was 30 – 34 kg/m^2 and 30 – 34 kg/m^2 respectively. Distribution of mean BMI of cases studied did not differ significantly between two study groups (P-value>0.05).

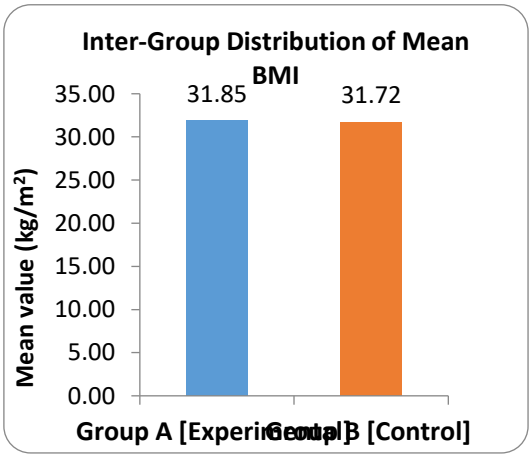

FIG.1: Inter-Group Comparison of mean body mass index (BMI) of cases studied.

Inter-group comparison of average (median) pre-test and post-test Flexion

The Median of pre-test Flexion of cases studied in Group A [Experimental] and Group B [Control] was 27.30 Sec and 25.15 Sec respectively. The minimum – maximum pre-test flexion range in Group A and Group B was 11.3 – 44.0 Sec and 8.0 – 45.0 Sec respectively. Distribution of median pre-test Flexion among the cases studied did not differ significantly between two study groups (P-value>0.05).

The Median of post-test Flexion of cases studied in Group A [Experimental] and Group B [Control] was 29.80 Sec and 26.00 Sec respectively. The minimum – maximum post-test flexion range in Group A and Group B was 13.4 – 46.9 Sec and 9.8 – 46.7 Sec respectively. Distribution of median post-test Flexion among the cases studied did not differ significantly between two study groups (P-value>0.05). The median % change in Flexion of cases studied in Group A [Experimental] and Group B [Control] was 9.16% and 5.00% respectively. Distribution of median % change in Flexion among the cases studied is significantly higher in Group A [Experimental] compared to Group B [Control] (P-value<0.001).

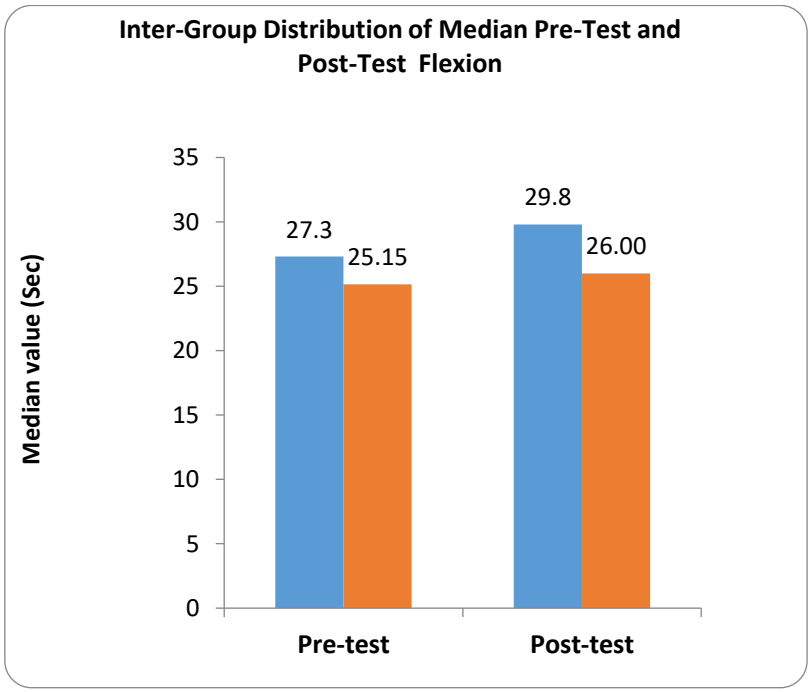

Figure 2) Inter-group comparison of average (median) pre-test and post-test parameters of McGill Endurance Test (Flexion).

Distribution of median pre-test and post-test Flexion in Group A

The median pre-test and post-test Flexion of cases studied in Group A [Experimental] was 27.30 Sec and 29.80 Sec respectively. Distribution of median pre-test Flexion among the cases studied is significantly lower compared to median post-test Flexion in Group A (P-value<0.001).

Distribution of median pre-test and post-test Flexion in Group B

The median pre-test and post-test Flexion of cases studied in Group B [Control] was 25.15 Sec and 26.00 Sec respectively.

Distribution of median pre-test Flexion among the cases studied is significantly lower compared to median post-test Flexion in Group B (P-value<0.001).

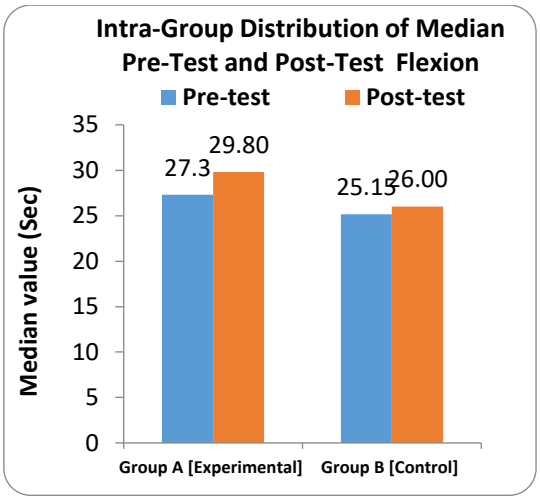

Figure 3) Intra-group comparison of average (median) pre-test and post-test parameters of McGill Endurance Test (Flexion).

Inter-group comparison of average (median) pre-test and post-test Extension

The Median of pre-test Extension of cases studied in Group A [Experimental] and Group B [Control] was 22.00 Sec and 21.00 Sec respectively. The minimum – maximum pre-test Extension range in Group A and Group B was 6.4 – 37.0 Sec and 5.4 – 45.0 Sec respectively. Distribution of median pre-test Extension among the cases studied did not differ significantly between two study groups (P-value>0.05). The Median of post-test Extension of cases studied in Group A [Experimental] and Group B [Control] was 24.60 Sec and 21.40 Sec respectively. The minimum – maximum post-test Extension range in Group A and Group B was 8.4 – 38.8 Sec and 6.7 – 47.0 Sec respectively. Distribution of median post-test Extension among the cases studied did not differ significantly between two study groups (P-value>0.05). The median % change in Extension of cases studied in Group A [Experimental] and Group B [Control] was 11.82% and 6.06% respectively. Distribution of median % change in Extension among the cases studied is significantly higher in Group A [Experimental] compared to Group B [Control] (P-value<0.001).

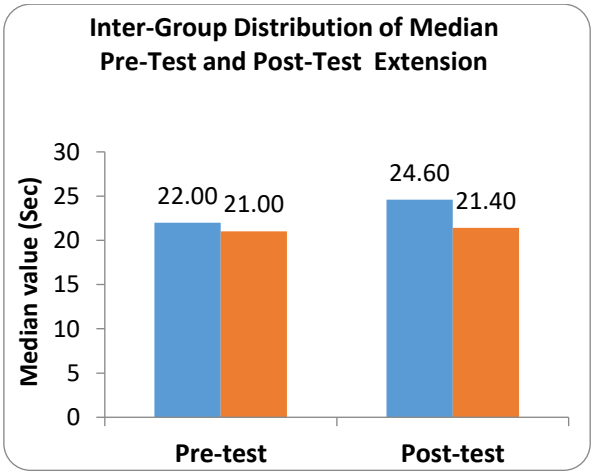

Figure 4) Inter-group comparison of average (median) pre-test and post-test parameters of McGill Endurance Test (Extension).

Distribution of median pre-test and post-test Extension in Group A

The median pre-test and post-test Extension of cases studied in Group A [Experimental] was 22.00 Sec and 24.60 Sec respectively. Distribution of median pre-test Extension among the cases studied is significantly lower compared to median post-test Extension Group A (P-value<0.001).

Distribution of median pre-test and post-test Extension in Group B

The median pre-test and post-test Extension of cases studied in Group B [Control] was 21.00 Sec and 21.40 Sec respectively. Distribution of median pre-test Extension among the cases studied is significantly lower compared to median post-test Extension Group B (P-value<0.001).

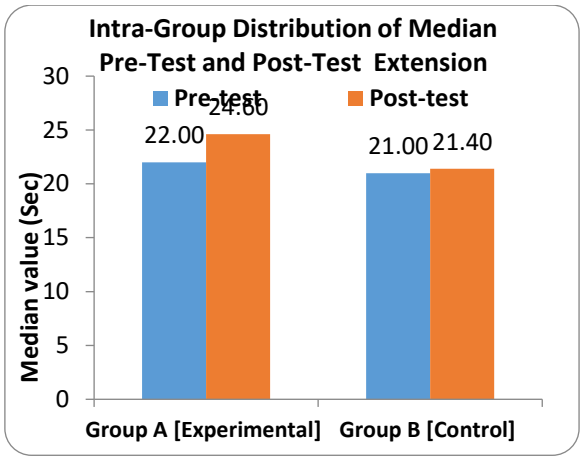

Figure 5) Intra-group comparison of average (median) pre-test and post-test parameters of McGill Endurance Test (Extension).

Inter-group comparison of average (median) pre-test and post-test RSP

The Median of pre-test RSP of cases studied in Group A [Experimental] and Group B [Control] was 15.20 Sec and 17.90 Sec respectively. The minimum – maximum pre-test RSP range in Group A and Group B was 5.0 – 36.0 Sec and 4.0 – 43.0 Sec respectively. Distribution of median pre-test RSP among the cases studied did not differ significantly between two study groups (P-value>0.05). The Median of post-test RSP of cases studied in Group A [Experimental] and Group B [Control] was 16.70 Sec and 18.90 Sec respectively. The minimum – maximum post-test RSP range in Group A and Group B was 6.7 – 38.6 Sec and 5.8 – 44.4 Sec respectively. Distribution of median post-test RSP among the cases studied did not differ significantly between two study groups (P-value>0.05). The median % change in RSP of cases studied in Group A [Experimental] and Group B [Control] was 17.69% and 4.60% respectively. Distribution of median % change in RSP among the cases studied is significantly higher in Group A [Experimental] compared to Group B [Control] (P-value<0.001).

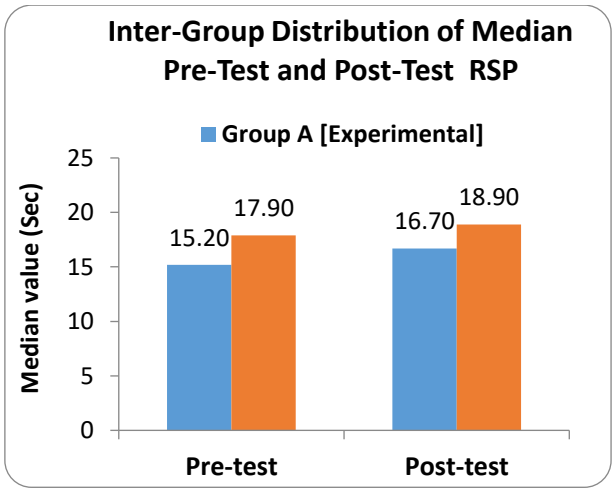

Figure 6) Inter-group comparison of average (median) pre-test and post-test parameters of McGill Endurance Test (RSP).

Distribution of median pre-test and post-test RSP in Group A

The median pre-test and post-test RSP of cases studied in Group A [Experimental] was 15.20 Sec and 16.70 Sec respectively. Distribution of median pre-test RSP among the cases studied is significantly lower compared to median post-test RSP Group A (P-value<0.001).

Distribution of median pre-test and post-test RSP in Group B

The median pre-test and post-test RSP of cases studied in Group B [Control] was 17.90 Sec and 18.90 Sec respectively. Distribution of median pre-test RSP among the cases studied is significantly lower compared to median post-test RSP Group B (P-value<0.001).

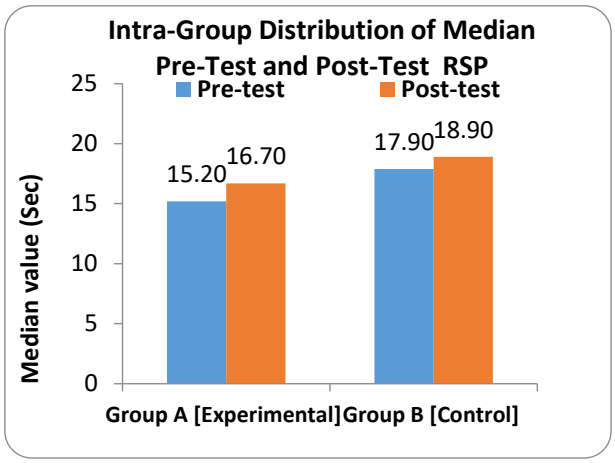

Figure 7) Intra-group comparison of average (median) pre-test and post-test parameters of McGill Endurance Test (RSP).

Inter-group comparison of average (median) pre-test and post-test LSP

The Median of pre-test LSP of cases studied in Group A [Experimental] and Group B [Control] was 13.30 Sec and 15.00 Sec respectively. The minimum – maximum pre-test LSP range in Group A and Group B was 4.4 – 38.4 Sec and 4.0 – 45.0 Sec respectively. Distribution of median pre-test LSP among the cases studied did not differ significantly between two study groups (P-value>0.05). The Median of post-test LSP of cases studied in Group A [Experimental] and Group B [Control] was 14.40 Sec and 15.70 Sec

respectively. The minimum – maximum post-test LSP range in Group A and Group B was 6.9 – 39.8 Sec and 5.4 – 46.2 Sec respectively. Distribution of median post-test LSP among the cases studied did not differ significantly between two study groups (P-value>0.05). The median % change in LSP of cases studied in Group A [Experimental] and Group B [Control] was 19.33% and 5.26% respectively. Distribution of median % change in LSP among the cases studied is significantly higher in Group A [Experimental] compared to Group B [Control] (P-value<0.001).

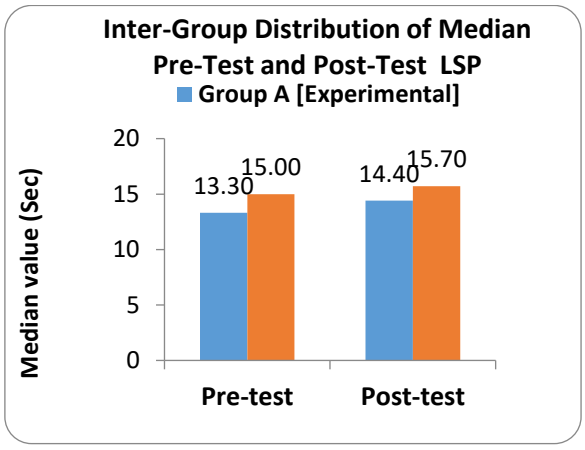

Figure 8) Inter-group comparison of average (median) pre-test and post-test parameters of McGill Endurance Test (LSP).

Distribution of median pre-test and post-test LSP in Group A

The median pre-test and post-test LSP of cases studied in Group A [Experimental] was 13.30 Sec and 14.40 Sec respectively. Distribution of median pre-test LSP among the cases studied is significantly lower compared to median post-test RSP Group A (P-value<0.001).

Distribution of median pre-test and post-test LSP in Group B

The median pre-test and post-test LSP of cases studied in Group B [Control] was 15.00 Sec and 15.70 Sec respectively. Distribution of median pre-test LSP among the cases studied is significantly lower compared to median post-test RSP Group B (P-value<0.001).

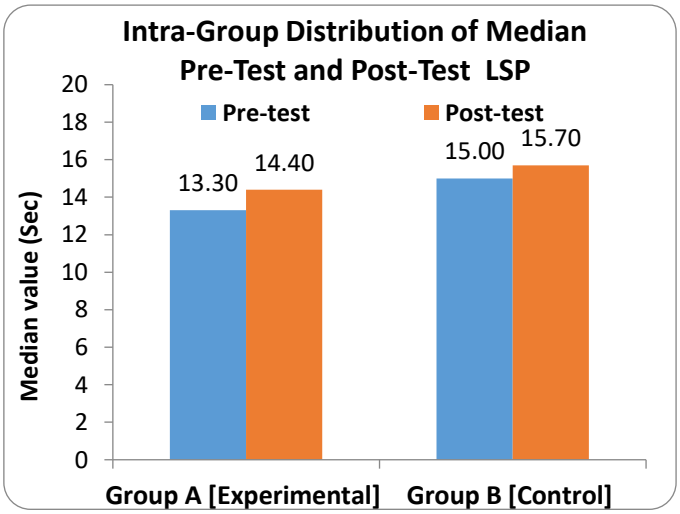

Figure 9) Intra-group comparison of average (median) pre-test and post-test parameters of McGill Endurance Test (LSP).

4. Conclusion

The present study was conducted to compare the effect of progressive core exercises versus general core exercises in individuals (females) with grade 1 obesity. It was an experimental study, with normal data in both the groups. The participants were divided into 2 groups, Group A (n=12) was given progressive core exercises and Group B (n=12) was given general core exercises. The protocol was given for 6 weeks at a frequency of 3 times a week. During the study, participant's pre and post data was calculated on McGill's endurance tests, including trunk 60^0 flexion test, trunk extension test, and side plank test (right and left). According to Naheemeh Haddidi et.al. [13], maximal score can be achieved when the test is performed 2 times by the individuals. Our study was conducted for 6-weeks, as review by Noelle M Selkow, [14] mentioned that neural conditioning occurs in 4-6 weeks whereas muscular strength develops in 6-8 weeks. Both the protocols showed significant improvement within group whereas among the group A showed highly significant improvement than group B. Hence, incorporating progressive core training in improving core endurance and will prove beneficial in treating conditions like low back pain and issues with lumbar spine and radicular symptoms.

In the study, flexor core endurance improved in progressive exercises group as compared to general core exercises. Supporting the statement, Susan Saliba [15] in her review describes about the **Dead-bug and abdominal hollowing** exercises particularly focusing on transverse abdominis muscle activation. Dead bug exercise promotes trunk and pelvic stabilization, and is performed with alternating arm and leg movements while maintaining transverse abdominis and obliques activation.

The extensor exercises like bridging, prone extension with arm or leg extension, exercises with four-point kneeling with arm and leg components, focus on erector spinae and multifidi. According to Hyun-Ju Park**,** [16] **Bridging** is recognized for enhancing neuromuscular control of trunk flexor and extensor muscles and strengthening pelvic and lower limb muscles. It is accepted clinically to facilitate functional control of trunk muscles and is often practiced. Incorporating hip movements with bridging benefits trunk stabilization by enhancing activation of local muscles. **Bird dog** or activities in **four-point kneeling position** is present in both protocols, suggesting its significance for improving core endurance. Veerle Stevens [17] conducted an EMG analysis to study four-point kneeling muscle activation. The study states that it is low-loading exercise, improving balance simultaneously focussing on a neutral spine.

Exercises focusing on obliques activation and overall core endurance included partial and full oblique curls, swiss ball activities in the study. The study revealed significant improvement in right and left plank in progressive group than general exercise group. Naeemeh Haddadi [13] mentioned in the study that right dominant subjects used their left trunk muscles for stabilizing trunk in daily activities, hence they were recruited during right side plank. The difference between right and left side plank readings, right sided plank had a greater improvement than left sided plank supporting the statement.

The swiss ball exercises are included in both groups in the study, as literature suggests these exercises promote co-activation of local and global muscles. R Stannon [18] comments that these exercises increase the muscle activity of abdominals and obliques more than stable surfaces.

Jason Brumitt, [19] in his review discusses 2 popular core stabilization strategies, first, emphasizing on motor control, i.e. specific training for local muscles hence promoting segmental stabilization, and second, general exercise, i.e. specific training for global muscles. Hence**,** in our view, progressive protocol focussed on local muscles whereas the general protocol focussed on global muscles.

Jason Burmitt [19] suggests a new 3 stage rehabilitation program; first stage, consisting exercises targeting at neuromuscular function of local muscles, second stage, closed chain segmental control exercises or

weightbearing exercises including stable or unstable surfaces to activate local and global muscles, and third stage, consisting open kinematic exercises promoting distal mobility, by incorporating co-activation of local and global muscles.

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