RESEARCH ARTICLE

INTERRATER AND INTRARATER RELIABILITY OF PRESSURE BIOFEEDBACK UNIT IN MEASUREMENT OF TRANSVERSES ABDOMINIS MUSCLE ACTIVATION IN ASYMPTOMATIC ADULTS

Disha Vallabhbhai Solanki[1] and Dr. Neela Soni[2]

1. PhD Scholar in Gujarat University, I/C Lecturer, Government Spine Institute and Physiotherapy College, Ahmedabad, India.
2. Ph. D. Guide in Gujarat University and Academic Director, SKUM College of Physiotherapy, Ahmedabad, India.

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Manuscript Info

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Abstract

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Background –The Transverse abdominis with its direct attachments to lumber vertebrae through thoracolumber fascia contributes as a local stabilizer of spine which have meaningful role for spinal stability. Transverse abdominis(TrA) activation is vital component in rehabilition of patients with Low back pain. The Pressure Biofeedback Unit (PBU) is a device designed to teach and measure Transverses abdominis activation by Abdominal draw-in maneuver which is often used by clinicians.

Methods – 60 healthy male and female subjects were selected for study. The abdominal draw-in test was performed with the subject in a prone lying position, and the Pressure Biofeedback Unit (Chattanooga Stabilizer) was utilized to evaluate the ability of the subject to perform this abdominal isolation test. For intrarater reliability, the examiner carried out the test twice at the interval of 2 days. For interrater reliability, 2 examiners did the test one after the other on the same day.

Results – Intraclass Correlation Coefficient (ICC) were calculated to determine interrater and intrarater reliability.ICC value for inter-rater reliability is 0.87 with 95% confidence interval (0.78-0.92). ICC value for intra-rater reliability is 0.86 with 95% confidence interval (0.79 – 0.93).

Conclusion - Pressure Biofeedback Unit shows good to excellent inter-rater and intra-rater reliability.

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Introduction:-

The Transverse abdominis arises from the thoracolumbar fascia at the lateral raphe, the internal aspects of the lower six costal cartilages, where it inserts with the diaphragm, the lateral third of the inguinal ligament and anterior two thirds of the inner lip of the iliac crest[1]. Its "belt-like" fiber orientation limits its ability to generate motion but emphasize its relationship to increasing intra-abdominal pressure [2], which is considered to have major effects on lumbopelvic stability [1]. The activation of the Transverse abdominis delayed in activation in low back pain patients. [3] and has similarly been identified to precede extremity movement in healthy individuals [4]

Corresponding Author:- Disha Vallabhbhai Solanki
Address:- PhD Scholar in Gujarat University, I/C Lecturer, Government Spine Institute and Physiotherapy College, Ahmedabad, India.

Transverse abdominis activation can be measured by various tools. It has been divided into laboratory test and clinical test. Laboratory test includes ultrasound imaging measures from a pressure sensor, Needle EMG and surface electromyography.[7] Most of the studies that have measured the activity of the deep abdominal wall muscles used fine-wire electromyography. However, this type of assessment is invasive, painful, uncomfortable, and costlier and may present the risk of infection.[8] Clinical tests involves the recruitment by palpation method[5] and by PBU.[6] But palpation method is subjective in nature so it requires skill of physiotherapist. Whereas with PBU, objective assessment can be done and evaluated.

Test should be conducted in prone lying with PBU (Stabilizer, Chattanooga, California, USA).[9] It is a reliable and valid clinical device for assessing deep abdominal muscle function, and has been used to develop a method for the careful monitoring of lumbar stabilization. [10,11] very few studies were available assessing reliability of pressure biofeedback unit in asymptomatic adults. Lima et al(2011) done systematic review on measurement properties of pressure biofeedback unit in the evaluation of TrA also suggested that TrA activity assessment yet to be answered and further studies are needed.[12] The purpose of the present study was to evaluate intra-tester and intertester reliability of the PBU.

Methods:-
In this study Sixty asymptomatic individuals those who are willingness to participate in this study both male and female between 19 - 40 years of age were randomly selected. Those whose Body mass index ≤ 24 is included in this study. Exclusion criteria's were Low back pain - subjects who has missed work due to back pain in preceding two years; Lumbar spine surgery ; Pregnancy ; Severe kyphosis or scoliosis; Spinal stenosis; Neurological disease; Cancer; Trauma to the lumbar spine; Nerve root entrapment

Rater description:-
Both examiners were trained Physiotherapist having sound knowledge of utility of PUB and skilled in assessing Abdominal drawing in maneuver.

Procedure:-
Subjects were called for the study through mouth to mouth publicity. Each subject was given subject information sheet and written consent were taken in vernacular language. Demographic data like height and weight of the subject was taken. Assessment of core strength (Transversus Abdominis) was done with Pressure Biofeedback Unit (PBU) (StabilizerTM, Chattanooga, California, USA). Familiarization was done with description of the task and demonstration of test performance. Adequate practice trials were given till the subject mastered the technique. The actual task i.e. Abdominal draw-in test was performed with the subject in a prone lying position on the hard surface with arms by the side and the PBU was placed under the abdomen with the navel in the centre and the distal edge of the pad in line with the right and left anterior superior iliac spines. The PBU was then inflated to 70 mmHg and was allowed to stabilize, allowing for detection of fluctuations in pressure due to normal breathing, which was approximately 2 mmHg for each inhalation and exhalation. Subjects were instructed to perform abdominal drawing in. The instructions were given to breathe in and out and then, without breathing in, to slowly draw in the abdomen so that it lifts up off the pad, keeping the spinal position steady. Deep inspiration was avoided. During this test, the investigator closely monitored the pressure gauge of the PBU and the subject to detect whether any compensatory mechanisms were employed, this included movements of the pelvis and spine, breathe holding, rib elevation and bulging of abdomen[15,16,17]. Then pressure reduction which was held at least up to 10 seconds was noted. Stop watch was used to note down the time. The same procedure was repeated for three times and average of the three repetitions was used for analysis. Rest time between the measurements was 1 min.

Fig.1:- Examiner scoring the Inter-Rater Reliability.

Fig. 2:- Examiner scoring the Intra-Rater Reliability.

For inter-rater reliability, both examiners did the test one after the other on the same day. For intra-rater reliability, the Examiner A carried out the test twice at the interval of 2 days. Following a period of instruction in the abdominal drawing-in test each subject was assessed in a randomized order during first visit by both the examiners. Both examiners and subjects were blind to the result of previous attempts.

On the first test day, Examiner A measured the first set. Subsequently, the participant had a 5-minute break and was able to get up from the plinth and walk around the test room before Examiner B measured the second set. To reduce order effect, the observer sequence was randomized in advance. On the second test day (i.e. after 2 days), test sets

were undertaken by Examiner A. On both test days, the participants were explicitly asked not to practice the Abdominal drawing in maneuver beyond the tests.[15]

Results:-

In this study total number of subjects were 60 among them 18 were male and 42 were female.

Table 1:- Demographic data of subjects.

Subjects	Mean	Standard Deviation
Age (years)	21.00	1.34
Height(cm)	162	6.64
Weight(Kg)	54	7.12

Inter-rater Reliability

Table 2:- Inter-rater reliability of PBU in measuring strength of Transversus Abdominis (TrA).

Intraclass correlation coefficient (ICC)	95% confidence interval (CI)	
	Lower bound	**Upper bound**
0.87	0.78	0.92

As shown in table 2 and graph 1, ICC value for inter-rater reliability of PBU in measuring strength of TrA was analysed based on mean rating, absolute - consistency, 2-way random effect model was 0.87 with 95% CI (0.78-0.92). The ICC values shows good to excellent reliability.
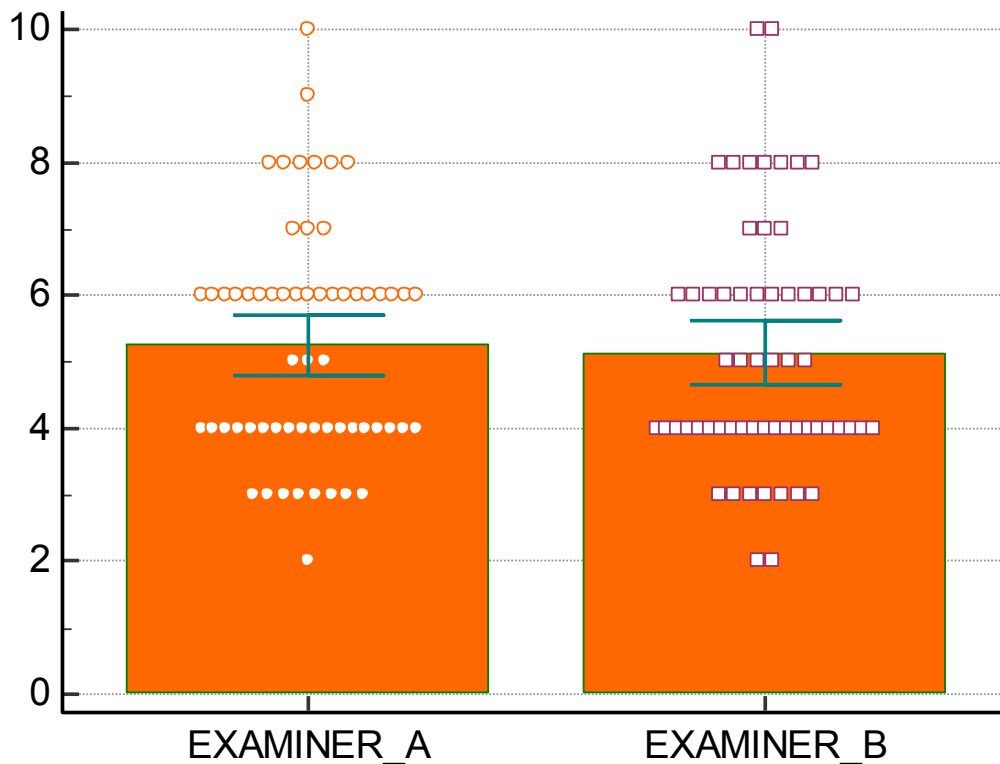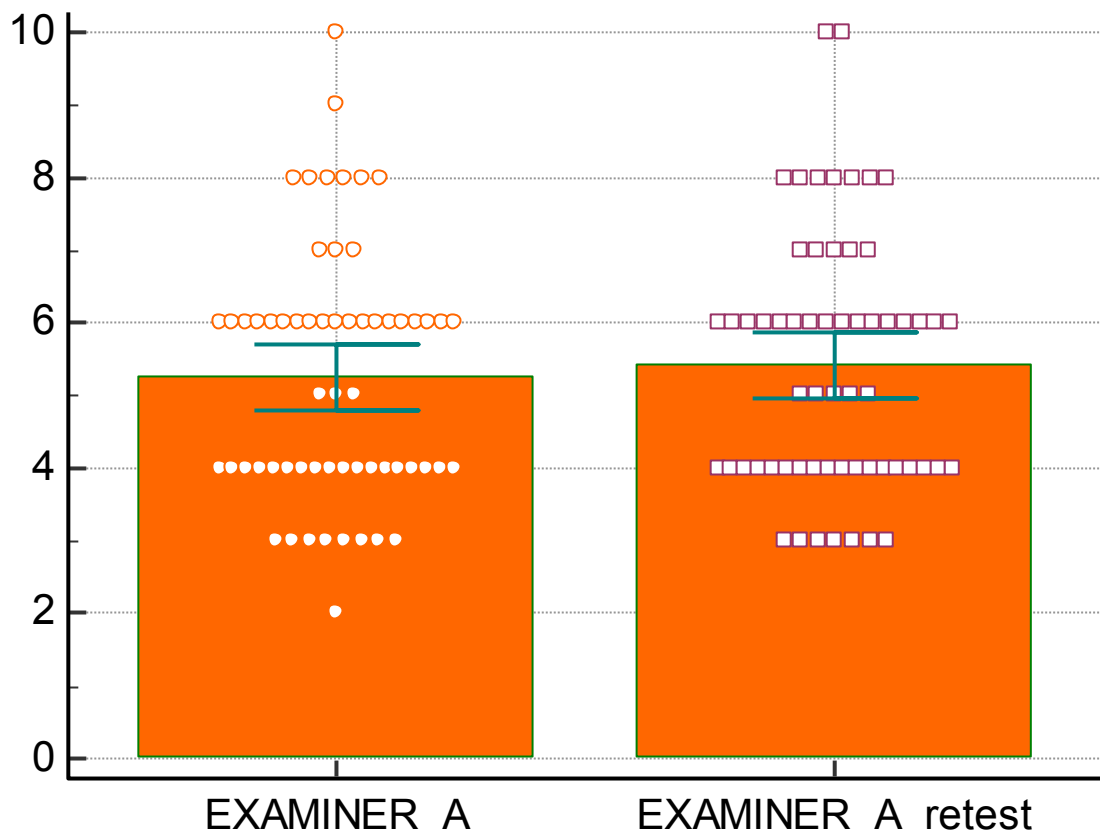

Graph 1:- Inter-rater reliability for PBU in measurement of strength of TrA.

Intra-rater Reliability

Table 3:- Intra-rater reliability of PBU in measuring strength of Transversus Abdominis (TrA).

Intraclass correlation coefficient (ICC)	95% confidence interval (CI)	
	Lower bound	**Upper bound**
0.86	0.79	0.93

As shown in table 3 and graph 2, ICC value for intra-rater reliability of PBU in measuring strength of TrA analysed based on mean rating, absolute – agreement, 2-way mixed effects model was 0.86 with 95% CI (0.79 – 0.93). The ICC values shows good to excellent reliability

Graph 2:- Intra-rater reliability for PBU in measurement of strength of TrA.

Discussion:-

The purpose of this study was to find out reliability of the PBU in asymptomatic adults. Thus, inter-rater and intra-rater reliability were done for PBU for measuring strength of Transversus Abdominis (TrA) in normal individuals. We had considered pressure reduction on PBU up to 10 mmHg over 10 seconds to be positive response while performing abdominal drawing in manoeuvre in prone lying position. The results of the reliability study found **good to excellent inter-rater reliability** with Intraclass correlation coefficient (ICC) value 0.87 (0.78-0.92) analysed based on mean rating, absolute-consistency, 2-way random effect model with 95% confidence interval (CI). **Intra-rater reliability was found to be good to excellent** with ICC value 0.86 (0.79 – 0.93) analysed based on mean rating, absolute – agreement, 2-way mixed effects model with 95% CI.

The PBU was found to congregate the need for quantification of the abdominal draw in action. As the TrA produces narrowing of the abdominal wall, measurement of the amount of movement of the abdomen that is produced provides a method of identifying a patient's ability to perform the contraction. The principle of using the PBU was that when the unit was placed under the abdomen, initially it conformed to the patient's shape. As the patient drew in the stomach off the pad, the pressure in the pad was indicated as reduced on the pressure dial. The pressure reduction was proportional to the degree to which the subjects could elevate the abdominal wall.

Our study is in agreement with the study done by Dilipbhai JK et al. who demonstrated intra-class correlation coefficient (ICC) with standard error of mean of 0.944 and 0.69725 for interrater reliability and 0.910 and 0.85814 for intrarater reliability and concluded that PBU has high inter-rater and intrarater reliability in asymptomatic individuals.[18]

However, our results did not agree with those of Storheim et al. who reported low test–retest reliability in a study of trained physiotherapy students without a history of back pain. They concluded that the device would not be sufficiently reproducible for use in training of healthy people, nor in low-back-pain research as an outcome measurement or for purposes of diagnosis or patient classification.[14]

Conclusion:-
Pressure Biofeedback Unit shows good to excellent inter-rater and intra-rater reliability. Thus it can be used as an objective measure to assess the Transverse Abdominis function.

Declaration of interest:-
Authors declare no conflict of interest.

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