

Comparison of Obliques Muscles Strength Between Left and Right Side in Normal Young Adults Using Handheld Dynamometer - A Pilot Study

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ABSTRACT

Background: Asymmetry of abdominal muscles is a potential cause for lowback pain. Most studies assume the rotational strength towards non dominant side to be more but no studies have been conducted to objectively measure the asymmetry. In subjects with spinal deformity like scoliosis which has a rotational component to it, it can be presumed that there could be asymmetry between the oblique force couple however this study aims to find out whether this asymmetry exists in normal healthy individuals. By using manual muscle testing for assessing oblique muscle strength only gross asymmetry can be detected. Therefore there is a need for more objective measure to detect subtle discrepancies within strength of both sides.

Objective: The objective of this study is to measure the strength of external and internal oblique on both side using handheld dynamometer and to compare the strength on both sides.

Methodology: 30 healthy young individuals in the age group of 18-30 years were selected to participate in the study. All subjects were right hand dominant. External oblique and internal oblique muscle strength was measured in KGs using a Jamartype of hydraulic handheld dynamometer.

Results: There was a significant difference between the strength of external obliques on right and left side with strength on right side being more whereas there was no significant difference between strength of internal oblique between right and left side.

Key Words: Oblique Muscle Strength, Handheld Dynamometer, Oblique Muscle Strength Asymmetry

INTRODUCTION

The core is defined as an anatomical box which consists of several muscle groups, such as the rectus abdominis at the front, the internal and external oblique on the lateral sides, the erector spinae, lumbar multifidus, quadratus lumborum at the back, the diaphragm at the upper edge and the pelvic floor, and the iliac psoas at the bottom. Transversus abdominis, lumbar multifidus, and quadratus lumborum

are considered key core muscles by health professionals while assessing and treating patients.¹

The internal oblique of ipsilateral side and external oblique of contralateral side form a force couple to rotate the trunk. Acting unilaterally, they perform rotation. Anterior fibers of external oblique working bilaterally flex the vertebral column, support and compress the abdominal viscera, depress the

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thorax and assist in respiration. Lateral fibers of external oblique work bilaterally to tilt the pelvis posteriorly. Lower anterior fibers of internal oblique compress and support the lower abdominal viscera. Upper anterior and lateral fibers of internal oblique depress the thorax. Therefore, apart from rotation they support the viscera, depress the thorax to provide stability for action of primary flexors of trunk.²

In previous studies, it was noted that multifidus muscles of patients with unilateral low backpain are asymmetric and it is thinner on the painful side.^[3] Also a clinical relationship was found between transverse abdominis muscle and lumbar multifidus muscle in patients with low backpain hence asymmetry of abdominal muscle can be a probable cause of low backpain.^[4] Chronic low backpain patients have been seen to have significantly lower Transverse abdominis muscle thickness. Also, the transversus abdominis asymmetry was higher in chronic low backpain patients.^[5] As both external and internal oblique are a part of core muscle. Their weakness and asymmetry in strength could also be a potential cause of low back pain. In addition, a subject with strong external oblique on one side on posture evaluation will have thorax extended and rotated on the stronger side due to posterolateral fibers of external oblique^[1] but in this case the conventional assessment would include assessing tightness of thoracolumbar fascia and assessment of scoliosis but the root issue may remain unaddressed until the asymmetry between the strength of external oblique is assessed. Moreover, it is proven that asymmetry of abdominal muscles is a more relevant and important factor than absolute values of abdominal muscles activity.⁶

Most studies have assumed the rotational strength towards non-dominant side to be more since due to functional activities the dominant side is in a more forward plane but no studies have objectively measured the difference between the muscles of both sides. Manual muscle testing which is generally used to test the strength of muscles is a subjective measure. Also, the manual muscle testing of abdominal muscles is based on attaining different postures using upper extremity and then performing the arc of motion

which becomes purely observational and does not give examiner an opportunity to feel the muscular effort. Therefore, these subtle asymmetries between the strength of oblique muscles on both sides are not assessed routinely in clinical setting as no objective measure is available to detect them.

There is limited literature assessing oblique muscles while analysing core muscle strength even when apart from trunk rotation they work synergistically with recti to flatten lumbar lordosis, raising lower leg in supine position, internal obliques contract during forward rotation of pelvis during gait.² There are ample of studies on transverse abdominis effect on segmental stability of spine and posture.⁷⁻⁹ By using manual muscle testing for assessing oblique muscle strength only gross asymmetry can be detected. Therefore there is a need for more objective measure to detect subtle discrepancies within strength of both sides.

MATERIAL and METHODOLOGY

30 Young healthy individuals in the age group 18-30 years were selected to participate in the study after obtaining approval from ethic committee and informed consent from the participant. All subjects were right hand dominant. Both male and female subjects were included. Individuals with spinal deformity, backpain and left hand dominance were excluded from the study.

TESTING OF EXTERNAL OBLIQUE MUSCLE STRENGTH

1. Starting position of subject was supine position with oppo site hip knee flexed, arms across the chest.
2. First the patient was instructed about the movement that is to be performed. Subject was asked to flex and rotate the trunk so that shoulder of the side to be tested is directed towards the iliac crest of opposite side.
3. Scapula on the side to be tested completely cleared the table.
4. Lower thoracic region remained in contact with the table.
5. Midpoint between medial end of clavi clean anterior axillary border was marked.

Similarly mark midpoint of dynamometer was marked. Subject was asked to attain the explained position. Midpoint of Dynamometer was placed on the marked point and subject was asked to resist force towards opposite side (isometric work). Subject was encouraged to give his maximum effort for 10 seconds which will be measured by a stop watch.

6. Participant was instructed not to hold breath.
7. Two readings were taken, best between both the readings was considered.

For testing of internal Oblique

1. Starting position was supine with same side hip knee flexed and foot resting on plinth. For testing of left internal oblique subject was asked to raise and rotate the left hemipelvis towards the right shoulder. The lower extremity remained relaxed. The subject was instructed to not to push from their heels.

2. Subject was asked to attain the explained position and a point midway between ASIS and pubic symphysis was marked. The midpoint of dynamometer was placed on this point.
3. Subject was asked to resist force towards opposite side (isometric work). Subject was encouraged to give his maximum effort for 10 seconds which was measured by a stopwatch. 4). Participant was instructed not to hold breath. Two readings were taken, best between both the readings was considered.

Statistical Analysis

The data was analyzed using Graph Pad Prism 9.2.0 software (1st August 2021). Data was first assessed for normality using the Kolmogorov-Smirnov test. For the data which passed the normality, Paired t test was used for comparison between the two sides. For the data which did not pass normality, Wilcoxon matched pairs signed-rank test was used for comparison between two sides. The confidence interval was set as 95% and significance level was set as 0.05. The data was considered as significant if $p < 0.05$.



Fig. 1: Midpoint of Dynamometer marked



Fig. 2: Testing of Left external oblique strength using clavicle as the landmark.



Fig. 3: Testing of Right Internal Oblique Strength.

RESULT

Table 1: Demographic data (gender) of subjects.

Gender	Number of Participants	Percentage
Females	19	63%
Males	11	37%

Table 2: Descriptive Statistics of Muscle Strength.

	Right external oblique	Left external oblique	Right internal oblique	Left internal oblique
MEDIAN	7	6.5	5	5
MEAN	7.16	6.7	5.13	5.06
STANDARD DEVIATION	1.234	1.418	1.252	1.437

Comparison between the external oblique strength on right and left side

Column B vs. Column A	Left vs. Right
Wilcoxon matched-pairs signed rank test	
Pvalue	0.0258
Exact or approximate P value?	Exact
P value summary	****
Significantly different (P<0.05)?	Yes
One-or two-tailed P value?	Two-tailed
Sum of positive, negative ranks	40.000, -150.00
Sum of signed ranks (W)	-110.00
Number of pairs	30
Median	0

Table 3: Comparison of outcome measures between the external oblique of right and left side.

- Wilcoxon matched-pairs signed rank test for comparison of outcome measures between External Oblique of Right And Left Side. The p value was found to be 0.0258 (i.e.<0.05) which shows statistically significant difference between the two sides.

Comparison Between the Internal oblique Strength on Right and Left Side

Table 4: Comparison of outcome measures between the internal oblique of right and left side.

Column B vs. Column A	Left vs. Right
Wilcoxon matched-pairs signed rank test	
Pvalue	0.7002
Exact or approximate P value?	Exact
P value summary	****
Significantly different (P<0.05)?	No
One-or two-tailed P value?	Two-tailed
Sum of positive, negative ranks	37.500, -28.500
Sum of signed ranks (W)	9.000
Number of pairs	30
Median	0

- Wilcoxon matched-pairs signed rank test for comparison of outcome measures between Internal Oblique of Right and Left

Side. The p value was found to be 0.7002 (i.e. >0.05) which shows no statistically significant difference between the two sides.

RESULT AND DISCUSSION

The objective of the present study was to determine the difference in strength between external oblique of right and left side, internal oblique of right and left side.

Subjects participating in the present study were between the age group of 18-30 years, with the mean age of 22.9 years. Total 30 Healthy young individuals agreed to participate in the study and met the inclusion criteria. Out of which, 63% were female and 37% were male. There was a female predominance in our study. All Participants enrolled in the study were right-handed individuals in order to remove the confounding factor of Hand dominance and since right handedness is the predominant trait in population. Also, a study by Paul et al reported that consideration of hand dominance was an important factor while studying response time and fatigability of erector spinae and multifidus.¹¹

The study concluded that there is significant difference between the strength of external obliques on right and left side with mean Strength of 7.1 KGs on right side and 6.7 KGS on left side whereas there was no significant difference between strength of internal oblique between right and left side with mean strength of 5.17 KGs on right side and 5.06 KGs on left side. The results of this study are in accordance with the study performed by Rankin et al where Ultrasonographic measures of thickness of lateral abdominal muscles was done. There was symmetry for total absolute thickness of Transverse abdominis, external and internal obliques but for individual muscles there was asymmetry of absolute size.¹²

Also, Park et al studied Ultrasound images of lateral abdominal muscles in healthy subjects while performing abdominal bracing at 50% and 100% contraction. Only Right-handed individuals were recruited. No significant difference was seen at rest and 50 % contraction However significant difference was seen at 100% contraction for

external and internal oblique with thickness on right side being more.¹³ External oblique was found to be thicker on dominant side which is in accordance with present study but internal oblique asymmetry was also found. Since the study required the participants to perform bracing at the abdomen which is not specific to obliques action. Ultrasonographic measurements are superior in measuring the precise thickness but may not predict functional strength of muscles as the muscle is not required to perform its action.

Paul et al investigated whether any cortical asymmetry exists between abdominal and limb muscles. He studied internal oblique, Deltoid and first dorsal interosseus in 10 healthy subjects. 3 subjects were left hand dominant. Transcranial magnetic stimulation was given to both left and right motor cortex and motor evoked potentials were recorded from the 3 muscles by EMG electrodes. Results showed that internal oblique had a strong ipsilateral component to it.¹⁴ The subjects who revealed left side bias were mostly right handed. Subjects with right bias were left and right handed both equally because 3 right handed subjects were not assessed due to technical errors. Therefore, opposite side cortical bias was seen for internal oblique in relation to hand dominance. Therefore asymmetry was seen in internal oblique which is not in line with our study however electrical activity of muscles were noted and not strength.

Axial Rotation of trunk is a common functional activity usually attributed to be one of the risk factors in back pain. Various studies have been done to assess asymmetry in abdominal muscles in athletes practicing asymmetrical sports like fast bowling. Axial rotation as a functional activity becomes asymmetrical in daily activities due to hand dominance. The study focused to find out whether the functional asymmetrical tasks could also cause difference in strengths between the two sides. In the present study, significant difference was found in strength of external oblique with the strength on right side being more while no difference was found in internal oblique strength. This could be since external oblique is a part of outer core and is a torque producing muscle while internal oblique is a stabilizing muscle. The torque producing external oblique functions as

mobility muscle on the base of stability muscle i.e internal oblique therefore external obliques would be performing rotations towards the non dominant side as daily activities are performed. Internal obliques on the other hand may contract simultaneously on both sides to provide stability for this action.

In contrast, in a study by Gray J et al, Ultra sono graphic measurements of lateral abdominal muscles were done in 25 adolescent cricket fast bowlers, of which 16 experienced chronic low back pain while 9 were asymptomatic. Asymptomatic individuals showed increased thickness of internal oblique, external oblique and transverse abdominis on non-dominant side.¹⁵ Internal oblique asymmetry is also seen in this population due to high force generation by dominant extremity while bowling which requires additional muscle activation in order to avoid torsional stress on lumbar spine. Bowlers with backpain were more symmetrical than without backpain. Therefore, asymmetry is a needed adaptation in this population. Interestingly, in a prospective study by Linek et al on adolescent soccer players, ultrasound images were recorded for internal oblique, external oblique and transversus abdominis at the end of expiration. In a 6 month observation period subjects who developed lowback pain were those who had internal oblique asymmetry¹⁶ initially. In soccer, symmetrical activation of core is required for the athlete to be more agile and have better performance. Therefore, internal oblique asymmetry in soccer player was not a sports specific demand. Hence, physical activity of the normal healthy subjects is an important Factor to be kept in mind while studying muscle strength on both sides. In the present study, no subjects were involved in recreational sports.

Butler et al studied electromyographic activity of back and abdominal muscle activation while lifting object with dominant and non-dominant extremity in Right handed individuals. No difference was found for activation of back muscles depending on whether lifts were done from right or left hand. However activation of external oblique changed depending on the hand that performed the lift. There was a greater

activation of right sided external oblique while performing lifts from left hand in comparison to activation of left side external oblique while performing lifts from right hand.¹⁷ Therefore, a handedness effect was seen for external oblique which is in line with finding of our study. However muscle activity pattern was studied in this study and not muscle strength.

CONCLUSION

1. There is a significant difference between the strength of external oblique on left and right side, with the strength of right external being more.
2. There is no significant difference between the strength of internal oblique of left and right side.

CONFLICT OF INTEREST: None.

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DECLARATION: The content in the manuscript has not been previously published and is not being concurrently submitted elsewhere.

ETHICAL CLEARANCE: Ethical clearance was given by the institutional ethics committee (IEC) of TNMC & BYL Nair Ch Hospital.

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