DOI: 10.37990/medr.1309485 Med Records 2023;5(3):518-22

MEDICAL RECORDS-International Medical Journal

Research Article

The effects of Q angle and Hamstring Length on Balance Performance in Patients with Lumbar Disc Hernia

Rukiye Ciftci

Gaziantep Islamic Science and Technology University, Faculty of Medicine, Department of Anatomy, Gaziantep, Türkiye

Abstract

Aim: Patellafemoral angle (Q angle) and Hamstring length are important measurements to evaluate balance. This study aims to examine the effects of Q angle and Hamstring length on balance performance in patients with lumbar intervertebral disc herniation (LDH).

Material and Methods: LDH (n=32) and control group (CG)(n=30) were included in the study. Q angles and hamstring muscle lengths of the participants were measured. Balance was evaluated with Y balance test.

Results: As a result of our study, no difference was found between LDH patients and CG groups in terms of hamstring muscle length; Q angle decreased in LDH patients and there was a negative high correlation between Q angle and R -Anterior, R-Posteromedial, R-Posterolateral values on the right and between Q angle and L-Anterior, L-Posteriolmedial, L-Posterolateral values on the left.

Conclusion: It was found that Q angle measurements decreased in LDH patients, causing genu varum and leading to impairment in balance, especially in the left anterior, anteromedial and anterolateral.

Keywords: Lumbar intervertebral disc herniation, patellafemoral angle, hamstring length, Y balance test

INTRODUCTION

Low back pain and radicular leg pain are common problems in physical medicine and rehabilitation. LDH is one of the most common causes of this type of pain (1, 2). When pain and shoulder instability develop, this process is evaluated pathologically and requires medical and/or surgical treatment. This degenerative process includes a wide variety of morphological changes, including large tears in anulus fibrosus. From these tears in the anulus fibrosus, especially from the radial tears, the nucleus pulposus herniates and LDH develops in patients (3,4). Patients with LDH experience sciatica symptoms affecting the lower extremities due to (primarily) nerve compression. These symptoms cause a decrease in knee strength (5).

Q angle has an important place in clinical evaluations and it is also frequently used to determine the condition of the lower extremity in cadavers (6). If the Q angle exceeds the limit of 15-20 degrees, it will cause injury to the knee extensor muscles and also increase the tendency of the patella to slide laterally. As a result, severe patella femoral pain will occur. Deterioration in the biomechanics of the knee joint and lower extremity also causes balance

CITATION
Ciftci R. The effects of Q angle and Hamstring Length on Balance Performance in Patients with Lumbar Disc Hernia. Med Records. 2023;5(3):518-22. DOI:1037990/medr.1309485

Received: 04.06.2023 **Accepted:** 30.06.2023 **Published:** .12.07.2023
Corresponding Author: Rukiye Ciftci, Gaziantep Islamic Science and Technology University, Faculty of Medicine, Department of Anatomy, Gaziantep, Türkiye
E-mail: rukiyekelesciftci@hotmail.com

disorders. In the literature review, it has been reported that the Q-angle is affected by the decrease in the speed of the quadriceps muscle with physical performance (7). Postural control and balance is the body's ability to keep its centre of gravity on the base of support, an essential requirement for independent mobility in daily life (8).

Clinical results have shown that shortening of the hamstring muscle is associated with specific conditions of the lumbar spine and general dysfunction of the lumbar region (9). Although the balance of the shortening of the hamstring muscles towards the back of the individual has not been fully clarified, knowing the effects of the short hamstrings on pelvic flexion and lumbar function during forward bending may guide the understanding of the problems in the cases. The idea that short hamstrings reduce pelvic flexion range of motion (ROM) when bending forward with the knees straight is supported by the results of studies measuring the contribution of posterior pelvic tilt to straight leg lift angle (SLL) (10). The aim of this study is to examine the effects of Q angle and Hamstring length on balance performance in LDH patients.

MATERIAL AND METHOD

In the power analysis conducted to determine the sample of the study, when the analysis was made according to Type I error (α) 0.05, power (1-β) 0.80 effect size 1.3, it was found that at least 50 participants, 25 healthy individuals and 25 LDH patients, should participate in the study (11). Individuals aged between 40 and 64 with and without a diagnosis of LDH who had not undergone surgery from the low back area and who did not have implants were included in the study, while patients who had undergone surgery from the low back area, those who had neurological disorders and those who had implants in the low back area were excluded from the study. As a result, a total of 62 individuals, patients with LDH (n=32) and healthy volunteers (n=30), participated in the study. Dominant extremities of all LDH patients and the control group were the right side.

Ethical Considerations

The study was conducted with the 2023/ 241 numbered of Non- interventional Clinical disquisition Ethics Committee. Written informed concurrence was attained from each party. The study was conducted in agreement with the declaration of Helsinki.

Data Collection Process

Demographic data and measurement results of each participant informed about the study were recorded. Hamstring muscle length of the participants was measured with Sit-Reach Test and balance was measured with Y Balance Test.

Assessment of Q Angle

The Q angle is measured by drawing a line (with a tape measure) from the spina iliaca anterior superior (SIAS) to the center of the patella. A new measurement is then made from the middle of the patella to the tuberositas tibia. To find the angle Q, measure the angle between these two measurements and then subtract 180 degrees.

The normal Q angle is 14 degrees in men and 17 degrees in women. An increase in the Q angle may indicate a higher risk of knee and knee problems (13).

Hamstring Length (Sit and reach test)

Baseline® (Cooper Institute/ YMCA, AAHPERD, New York, USA) device was used to measure hamstring length. Participants were asked to get into a long sitting position. They were then asked to place the soles of their feet on the test device and lie down three times to warm up. Then, the arm lengths of the subjects on the device were determined and they were asked to reach forward as much as possible by pressing the measuring device without raising their knees. This process was done three times and the average was recorded (14).

Y Balance Test (YBT)

Dynamic balance capability was determined by using Y Balance Test. Before the measures, the participants were given instructions about how the test would be performed and they watched videos. Regarding the knowledge effect, 6 operations were made before the sanctioned measures (15). After completing the test trials, a 2- minute break was given, followed by 3 test trials in each direction. All actors performed the Y Balance Test with the side they preferred in strength test. In this test, while actors stand in balance on one bottom, they are asked to reach as important as possible in three different directions with the other bottom at the same time anterior, posterolateral and posteromedial. For this reason, this test measures the strength, stability and balance of athletes in different directions. YBT emulsion score is calculated by adding 3 directions of reach and homogenizing the results to lower extremity, while asymmetry is the difference between right and left extremity reach (16).

Statistical Analysis

SPSS 25 was used in the study for statistical analyses. Normality analysis of the data was performed according to Kolmogrov Simirnov method and the data were found to be normally distributed. Levene test was used for homogeneity of variances. Independent Samples T Test was conducted to compare dynamic balance, hamstring length and Q angles of LDH group and CG. Pearson Correlation Coefficient was used to determine the relationship of Q angle and hamstring length with balance performance. Level of significance was determined as 0.05 in the study.

RESULTS

When the demographic data of the study were examined, while mean age was 49.12 in the LDH group, it was 51.40 in the CG. Mean height was 160.12 in the LDH group, while it was 170.86 in the CG. Mean weight was 64.3 in the LDH group, while it was 70.33 in the CG. BMI values were 25 in the LDH group and 23.77 in the CG (Table 1).

Table 1. Descriptive information of the participants

Parameters	LDH N=32	CG N=30
Age (Years)	49.12±6.59	51.40±6.64
Height (cm)	160.12±6.36	170.86±9.91
Weight (kg)	64.31±10.42	70.33±18.05
BMI(kg/m2)	25.00±3.42	23.77±4.21

BMI: body mass index

Table 2 shows Q angle, Y balance test results and hamstring lengths of the participants. According to the results, significant difference was found between LDH group and CG in terms of hamstring length (t=6.728, p<.001), QA (t=-3.124, p=.003), R-Anterior (t=-4.643, p<.001), R-Posteromedial (t=-6.320, p<.001), R-Posterolateral (t=-4.989, p<.001), L-Anterior (t=-4.817, p<.001), L-Posteromedial (t=-4.848, p<.001), L-Posterolateral (t=4.532, p<.001) (Figure 1) (Table 2).

Table 2. Right and left extremity Q angle and Y balance measurement results of the participants

Parameters	LDH N=32	CG N=30	t	p
R-QA	9.56±0.80	10.46±1.38	-3.124	.003
R-Anterior (%)	99.59±12.36	116.14±15.59	-4.643	<.001
R-Posteromedial (%)	94.88±10.27	123.06±22.29	-6.320	<.001
R-Posterolateral	101.33±14.30	128.96±26.98	-4.989	<.001
L-QA	9.56±0.80	10.46±1.38	-3.124	.003
L-Anterior (%)	103.42±11.91	119.71±14.49	-4.817	<.001
L-Posteriolmedial (%)	95.41±9.82	119.96±26.06	-4.848	<.001
L-Posterolateral (%)	104.00±9.15	127.92±27.51	-4.532	<.001
Hamstring Length	14.31±5.01	-1.06±11.85	6.728	<.001

R-Anterior (Y balance): right anterior balance, R-Posteromedial: right posteromedial balance, R-Posterolateral: right posterolateral balance; L-Anterior: left anterior balance, L-Posteromedial: left posteromedial balance, L-Posterolateral: left posterolateral balance

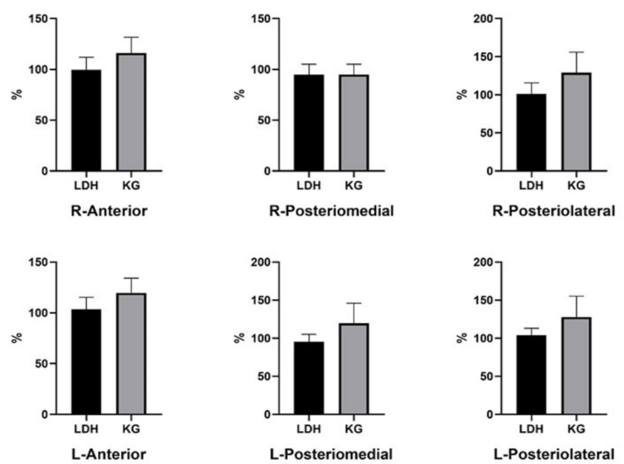

Figure 1. Comparison of Y balance performances of the participants

Table 3 shows the analysis of the relationship between participants' Q angle and hamstring length and dynamic balance performance. According to the table, negative high correlation was found between participants' Q angle and L-Anterior (r=-.564, p=.001) and L-Posterolateral (r=-.792, p=.000) (p<0.05). Negative high correlation was found between participants' Hamstring length and L-Posteromedial (r=-.719, p=.000) reach distance (p<0.05) (Table 3).

Table 3. Relationship of Q angle and hamstring length with balance performance in individuals with LDH

Variables	Q angle	Hamstring length
R-Anterior (%)	r= -.161, p=.378	r= -.186, p=.309
R-Posteromedial (%)	r= -.297, p=.099	r= .442, p=.011
R-Posterolateral	r= -.161, p=.379	r= .140, p=.446
L-Anterior (%)	r= -.564, p=.001*	r= -.180, p=.323
L-Posteriolmedial (%)	r= -.329, p=.066	r= -.719, p=.000*
L-Posterolateral (%)	r= -.792, p=.000*	r= -.560, p=.001

R-Anterior (Y balance): right anterior balance, R-Posteromedial: right posteromedial balance, R-Posterolateral: right posterolateral balance, L-Anterior: left anterior balance, L-Posteromedial: left posteromedial balance, L-Posterolateral: left posterolateral balance

DISCUSSION

In this study which aimed to find out the effects of Q angle and Hamstring length on balance performance in LDH patients, Q angle was found to decrease in LDH patients and a high negative correlation was found on the right in R-Anterior, R-Posteromedial, R-Posterolateral valıes and on the left in L-Anterior, L-Posteriolmedial, L-Posterolateral values.

The Q angle is an important mechanism in the musculoskeletal system. Changes in the Q angle cause the extensor mechanism to deteriorate and can cause balance problems by causing hypermobility and patellar instability in the knee joint (17). Although Q angle is frequently used in determining knee pathologies (18), its use in LDH patients is limited. However, it is known that knee pathologies develop secondary to the disease in LDH patients (19).

In a study conducted in literature, Q angles of individuals who are engaged in physical activity and those of sedentary individuals were compared and Q angle was found to be narrower in individuals who were physically active (20). In another study, it was reported that Q angle was associated with the strength applied by quadriceps femoris to the patella and lateral and therefore athletes could have lower Q angles (21). Due to such reasons, the effect of transmitted muscle strength will increase as Q angle gets smaller, in other words, as the angle gets narrower. In our study, it was found that anterior, posteromedial and posterolateral balance increased in the left extremity as Q angle decreased in LDH patients. However, this result was not found in the right extremity. We believe that this result was due to the fact that the left extremity was the supporting leg.

Decrease in Q angle will cause the pathology called genu verum which causes the knee to make an angle to the lateral. In this case, the load on the knee will not be evenly distributed, causing pain in the low back and knee area (22). In LDH patients, the body's centre of gravity will change and the knee will have more load due to increasing pain. In our study, we found that Q angle was lower in LDH patients (23). In this case, our study supports the literature.

If hamstrings are shorter, pelvic tilt becomes limited and looser spinal tissues will stretch (24). In addition, since hamstrings can change the transmission of force between the lower limbs and the trunk and can maintain excessive erector spine electromyography activity during dynamic activities (25), hamstring shortness will affect low back and hip functions (26). These assumptions lead to the hypothesis that hamstring shortness may affect trunk and pelvic dynamics during manual material transport.

Hamstring flexibility is considered an important component of physical fitness and plays an important role in protecting the spine (27). Shortened hamstring extensibility has been suggested as a predisposing factor for low back disorders and changes in lumbopelvic rhythm (28). In our study, we found that hamstring muscle was shorter in LDH patients when compared with CG, although not statistically significant.

CONCLUSION

As a result of the study, it was found that Q angle measurements decreased in LDH patients, leading to genu varum and as a result of this, balance was deteriorated especially in the left anterior, anteromedial and anterolateral. It is recommended that health professionals who prepare treatment protocol to LDH patients should give exercises that will specifically develop balance in these directions.

Financial disclosures: *The authors declared that this study has received no financial support.*

Conflict of Interest: *The authors have no conflicts of interest to declare.*

Ethical approval: *The study was conducted with the 2023/ 241 numbered of Non- interventional Clinical disquisition Ethics Committee. Written informed concurrence was attained from each party.*

REFERENCES

1. Abramovitz JN, Neff SR. Lumbar disc surgery: results of the prospective lumbar discectomy study of the joint section on disorders of the spine and peripheral nerves of the American Association of Neurological Surgeons and the Congress of Neurological Surgeons. Neurosurgery. 1991;29:301-8.
2. Atlas SJ, Deyo RA, Keller RB, et al. The maine lumbar spine study, part II: 1-year outcomes of surgical and nonsurgical management of sciatica. Spine (Phila Pa 1976). 1996;21:1777-86.
3. Modic MT, Ross JS. Lumbar degenerative disk disease. Radiology. 2007;245:43-61.
4. Waris E, Eskelin M, Hermunen H, et al. Disc degeneration in low back pain: a 17-year follow-up study using magnetic resonance imaging. Spine (Phila Pa 1976). 2007;32:681-4.
5. Karvonen MJ, Viitasalo JT, Komi PV, et al. Back and leg complaints in relation to muscle strength in young men. Scand J Rehabil Med. 1980;12:53-9.
6. Şenol D, Altinoğlu M, Toy Ş, et al. Investigation of the relationship of Q Angle and stork balance stand test with somatotype in healthy young individuals. Medical Records. 2019;1:60-6.
7. Citaker S, Kaya D, Yuksel I, et al. Static balance in patients with patellofemoral pain syndrome. Sports Health. 2011;3:524-7.
8. Lihavainen K, Sipilä S, Rantanen T, et al. Contribution of musculoskeletal pain to postural balance in community-dwelling people aged 75 years and older. J Gerontol A Biol Sci Med Sci. 2010;65:990-6.
9. Halperin N, Copeliovitch L, Schachner E. Radiating leg pain and positive straight leg raising in spondylolysis in children. J Pediatr Orthop. 1983;3:486-90.

10. Bohannon R, Gajdosik R, LeVeau BF. Contribution of pelvic and lower limb motion to increases in the angle of passive straight leg raising. Physical Therapy. 1985;65:474-6.
11. Yilmaz A, Kabadayi M, Mayda M, et al. Analysis of Q angle values of female athletes from different branches. Sci Mov Heal. 2017;17:141-6.
12. Baumgartner RN, Chumlea C, Roche AF. Bioelectric impedance for body composition. Exerc Sport Sci Rev. 1990;18:193-224.
13. ELİÖZ M, Tülin A, Ajlan S, YAMAK B. The investigion of the relatonship between some physicial features with Q angle in athletes and sedanteries. Spor ve Performans Araştırmaları Dergisi. 2015;6:58-65.
14. Akınoğlu B, Paköz B, Hasanoğlu A, Kocahan T. Investigation of the relationship between sit-and-reach flexibility and the height, the leg length and the trunk length in adolescent athletes. Balt J Health Phys Act. 2021;13:29-37.
15. Hertel J, Miller SJ, Denegar CR. Intratester and intertester reliability during the star excursion balance tests. Journal of Sport Rehabilitation. 2000;9:104-16.
16. Coughlan GF, Fullam K, Delahunt E, et al. A comparison between performance on selected directions of the star excursion balance test and the Y balance test. J Athl Train. 2012;47:366-71.
17. Akman MN, Karataş M. Temel ve uygulanan kinezyoloji. In: Kinezyoloji. Haberal Eğitim Vakfı. 1th, Rize, 2003;123-8.
18. Almeida GPL, França FJR, Magalhães MO, et al. Q-angle in patellofemoral pain: relationship with dynamic knee valgus, hip abductor torque, pain and function. Rev Bras Ortop. 2016;51:181-6.
19. Jeon H, Lee S-U, Lim J-Y, et al. Low skeletal muscle mass and radiographic osteoarthritis in knee, hip, and lumbar spine: A cross-sectional study. Aging Clin Exp Res. 2019;31:1557-62.
20. Bayraktar B, Yucesir I, Ozturk A, et al. Change of quadriceps angle values with age and activity. Saudi Med J. 2004;25:756-60.
21. Schulthies SS, Francis RS, Fisher AG, Van De Graaff KM. Does the Q angle reflect the force on the patella in the frontal plane? Phys Ther. 1995;75:24-30.
22. Karabulut M. Evaluation of the Relationship among radiological grading with q angle, femoral cartilage thickness and clinical parameters in patients with the knee osteoarthritis. Master thesis, Bursa Uludag University Bursa, 2018.
23. Oken O, Koybasi M, Tuncbilek I, Ayhan F, Yorgancioglu RZ. The association of presacral nodules with biomechanics of the lumbar region and lumbar discopaties in patients with low back pain. Turk J Phys Med Rehab. 2010:56:18-21.
24. Norris CM. Back stability: Human Kinetics Publishers. In: Scope of the Problem. 2nd edition. CRC Press, United Kingdom, 2000;317-22.
25. Kroll PG, Raya MA. Hamstring muscles: an overview of anatomy, biomechanics and function, injury etiology, treatment, and prevention. Critical Reviews in Physical and Rehabilitation Medicine. 1997;9:191-203.
26. Shin G, Shu Y, Li Z, Jiang Z, Mirka G. Influence of knee angle and individual flexibility on the flexion–relaxation response of the low back musculature. J Electromyogr Kinesiol. 2004;14:485-94.
27. Muyor JM, López-Miñarro PA, Casimiro AJ. Effect of stretching program in an industrial workplace on hamstring flexibility and sagittal spinal posture of adult women workers: a randomized controlled trial. JJ Back Musculoskelet Rehabil. 2012;25:161-9.
28. Carregaro RL, Coury HJCG. Does reduced hamstring flexibility affect trunk and pelvic movement strategies during manual handling? International Journal of Industrial Ergonomics. 2009;39:115-20.