Research Article
Volume 12:3, 2023

Journal of Spine

ISSN: 2165-7939 Open Access

Flat Lumbar Lordosis Spinal Alignment is Over Represented in Young Individuals with Symptomatic Lumbar Disc Herniation

Joel Mattias Beck*, Helena Brisby, Adad Baranto and Olof Westin

Department of Orthopaedics, Gothenburg University and Sahlgrenska University Hospital, Gothenburg, Sweden

Abstract

Background: The lumbar spine and pelvis can be aligned in a variety of different ways. It has been demonstrated that certain lumbar morphological characteristics can affect the likelihood of developing speci ic illnesses, such as Lumbar Disc Herniation (LDH) or spondylolysis. This study's main objective was to look at the sagittal pro iles of young individuals having lumbar disc herniation surgery. Checking if a straightforward discectomy altered the sagittal features following surgery was a secondary objective.

Methods: The study comprised 16 young patients with lumbar disc herniation surgery (mean age 18.3 and 3.2 SD). Erect sagittal radiographs of the entire spine were taken prior to surgery. According to Roussouly, two experienced spinal surgeons classi ied the sagittal features. Additionally, a whole spine erect radiograph was taken three months following surgery and prospective changes in sagittal spinopelvic pro iles were assessed.

Results: The patients in the study exhibited a strong low lumbar lordosis dominance, with more than 75% of the patients having Roussouly sagittal pro iles type 1 and type 2. Examining the erect radiographs revealed that the post-operative sagittal pro ile had undergone only small, insigni icant modi ications.

Conclusion: In conclusion, this study shows that, when young patients with LDH are compared to a normal population cohort, the sagittal spinal alignment, as de ined by Roussouly, is skewed and does not appear to be changed or altered by the disc herniation condition or the surgical intervention in and of itself. The Roussouly type 1 or 2 spinal sagittal pro ile was present in the vast majority of the young LDH patients who presented for surgery, suggesting that this may be thought of as a separate risk factor for the development of LDH in this cohort.

Keywords: Spinal sagittal alignment • Spinopelvic parameters • Adolescent lumbar disc herniation • Roussouly classi ication

Introduction

A Lumbar Disc Herniation (LDH) may be more likely to occur in certain spinal sagittal profiles. In particular at the L4-L5 and L5-S1 levels, a flat spinal profile with low lumbar lordosis (or flat back) has been associated to an increased risk of disc degeneration, predisposing these individuals to develop pathological degeneration and subsequent disc herniation. On the other side, it has been suggested that an excessive lumbar spine curve, such as hyperlordosis, increases the stress and shear pressures over the lower lumbar facet joints, possibly leading to spondylolisthesis and then spondylolysis [1].

The most popular categorization is the Roussouly classification, which categorises spinal subtypes and their associated morphology into four fundamental sagittal profiles according to the degrees of pelvic characteristics, angulation in lumbar lordosis and thoracolumbar kyphosis that each profile exhibits [2].

Previous studies have shown that the degree of lumbar lordosis is impacted by lumbar disc herniation. The sagittal misalignment may, in theory, be able to be corrected by recovery from disc herniation-induced discomfort and muscular spasms, whether through surgical discectomy or conservative treatment [3].

Sagittal parameters

The Pelvic Incidence (PI) has been found to be constant across all spinal measurements. Similar to this, altering pelvic tilt, sacral slope and to a lesser extent, thoracic kyphosis are the only ways to alter sagittal alignment. As a result, Lumbar Lordosis (LL) is predominantly controlled by inborn pelvic form and architecture. However, PT, which is primarily regulated by hip flexion and lower limb location, also has an impact on LL. In conclusion, the LL is

***Address for Correspondence:** Joel Mattias Beck, Department of Orthopaedics, Gothenburg University and Sahlgrenska University Hospital, Gothenburg, Sweden; E-mail: PJM.BECK@GMAIL.COM*

Received: 21 August, 2019, Manuscript No. JSP-23-1472; **Editor assigned:** 24 August, 2019, Pre QC No. P-1472; **Reviewed:** 07 September, 2019, QC No. Q-1472; **Revised:** 30 June, 2023, Manuscript No. R-1472; **Published:** 28 July, 2023, DOI: 10.37421/2165-7939.2023.12.594

brought on by genetic factors, lower limb position and (in) voluntary muscle activation in the thoracolumbar paravertebral musculature. Normal sagittal alignment ranges in a healthy population have been established by prior studies [4].

Adolescent lumbar disc herniation surgery

Surgery for disc herniation in young individuals is an uncommon and infrequent spine procedure. In Sweden, a country in Western Europe, 20 LDH treatments are administered annually per 100,000 people, compared to 0.6 per 100,000 for young patients under the age of 20. LDH in children and adolescents has a different aetiology and clinical course than in adults. Young people often experience more low back pain, less sciatica and longer overall pain duration before a diagnosis of LDH is made and surgery is carried out. Although they have preoperative clinical symptoms and results that are similar to or worse than adult patients with LDH, adolescents typically undergo more conservative treatment [5].

However, young patients appear to recover more quickly from surgery and have a better prognosis overall than older ones. The lumbar discs of young patients exhibit distinct structural and morphological characteristics from mature discs in adults, which may be one explanation for this. Since the nucleus pulposus and annulus fibrosus are less likely to fail structurally and produce a higher proportion of covered disc herniations, the LDH is less likely to spontaneously resorb than in the adult population. This finding might necessitate lowering the previously advised surgical threshold for this population [6].

The study's major premise is that a low lumbar lordosis is over-represented in a sample of young individuals with LDH who require surgery. A secondary goal was to look into changes in the sagittal profile after surgery [7].

Materials and Methods

Regardless of the type of surgery done, the study included all patients under the age of 25 who visited the spinal unit at Sahlgrenska university hospital in Gothenburg, Sweden, between 2014 and 2018 with a symptomatic lumbar disc herniation that was causing back pain or severe sciatica at the L4-L5 or L5-S1 level and necessitating surgical treatment [8]. To lessen the effect of aging-related lumbar disc and facet joint degeneration on sagittal spinal alignment, the age restriction was imposed at 25 years old. All of the patients had at least three months of experience with physiotherapy, medication or other conservative therapies before having surgery. The demographic data for the study population is shown in Table 1 [9].

Gender	Males (37%)	Females (63%)
Age	20 ± 3.2	17.7 ± 3.2
Level of surgery	L4-L5 50%	L4-L5 10%
	L5-S1 50%	L5-S1 90%
Pain duration	18 mts (range 8-30)	18 mts (range 3-36)

Table 1. Study population demographics.

Imaging examinations

To con irm the diagnosis and determine the anatomical features and morphology of disc material, extrusion and LDH nerve root affection, all patients received at least one 1.5T or 3.0T MRI prior to surgery. Additionally, pre-operative and three-month post-operative upright radiographs with Anteroposterior (AP) and lateral perspectives were used to assess sagittal spinopelvic features. From the upper cervical spine to the proximal region of the femurs, the whole spine including the hip joints was visible on this upright radiograph of the spine. The patient was positioned in a standardised body position for a diagnostic sagittal radiograph, with their feet at shoulder width, their upper limbs crossed over their chest and their hands resting on top of their clavicles [10].

Standing in this unsupported position, the radiograph was obtained in the lateral plane. The results of this radiological procedure were consistent with past studies on spinopelvic parameters. The sagittal alignment was categorised by two spinal surgeons/observers, who also measured the Thoracic Kyphosis (TK), Lumbar Lordosis (LL), Sacral Slope (SS), Pelvic Tilt (PT) and Pelvic Incidence (PI), as well as a categorization that matched Roussouly et al. in the four previously mentioned subtypes. The measurement accuracy in each radiograph as well as the inter-rater reliability between the two observers were determined by a separate statistician [11].

Surgical procedures

The lumbar discs of each subject in this study were surgically removed. Surgical lumbar techniques included transforaminal endoscopic operations, conventional mini-open discectomy and percutaneous full endoscopic interlaminar discectomy. All of these procedures are frequently performed in contemporary clinical settings and numerous papers have documented the surgical techniques used. The results of several surgical procedures to treat LDH have been deemed equivalent in terms of long-term outcomes [12].

Statistics and data analysis

The patient's radiological data was sent to surgimap, where radiographic evaluations were made. The radiography data were imported into IBM SPSS Statistics for Mac, Version 24.0, Armonk, NY, IBM corp., where they were exported for further analysis. The mean and Standard Deviation (SD), median and range or frequencies and percentages, as applicable, were used to statistically describe the data. The signi icant difference between pre- and post-operative X-rays was determined using student's t-test [13].

Pearson's correlation coefficient was utilised to compare the correlation between the sagittal characteristics in the pre- and post-operative erect radiographs. The two-sample proportion comparison was carried out using the two sample z-test. Each test's significance level was set at p 0.05 and all tests were two-sided. Changes in radiographic parameters were expressed as (degrees SD) [14]. To calculate the inter-rater reliability of the measurements (two-way random model, absolute agreement, single measurements), the Intraclass Correlation Coefficient (ICC, 2,1) was utilised. The classification method developed by Fleiss was used to classify the degree of agreement between the ICC values. Low reliability is indicated by an ICC value less than 0.40, fair to high reliability is indicated by a value between 0.4 and 0.75 and outstanding dependability is indicated by a value more than 0.75 [15].

Results

Patient metrics and baseline characteristics

The patient population's history and demographic data are shown in Table 1. In this study, there were 12 more female participants than male participants (63 *vs.* 37%). Four of the patients had LDH at the L4-L5 level, while twelve had LDH at the L5-S1 level. Back pain and unilateral sciatica were present in all of the patients.

Interobserver correlation of radiographic measurements

A review of the radiographic evaluation revealed a good level of agreement and moderate inter-observer reading variability. Table 2 demonstrates that there was strong agreement between the interobserver pelvic measures, with intraclass correlation values ranging from 0.75 to 0.95.

The modifications to the spinal sagittal parameters are shown in Table 3. All subsequent changes in LL were therefore attributed to variations in PT and SS because PI stayed within the measurement error throughout the whole process. None of the sagittal profile changes were statistically significant and all other changes were within the measurement error.

Measurement	Intraclass correlation	95% conf. interval	P-value
Sacral slope	0.86	0.64-0.95	<0.001
Pelvic incidence incidence	0.75	0.64-0.91	<0.001
Pelvic tilt	0.89	0.73-0.96	<0.001
Lumbar lordosis	0.94	0.79-0.97	<0.001
PI-LL	0.93	0.83-0.98	<0.001
Post-operative measurements			
Sacral slope	0.76	0.64-0.95	<0.001
Pelvic incidence	0.82	0.54-0.94	<0.001
Pelvic tilt	0.93	0.79-0.97	<0.001
Lumbar lordosis	0.9	0.72-0.96	<0.001
PI-LL	0.95	0.87-0.98	<0.001

Table 2. Inter-rater variability and validity for the sagittal measurements.

Roussouly	1		2		3		4	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
PT	11.5 (28)	11.5 (23)	15 (24)	13.5 (20)	10 (16)	6 (2)	0 (3)	3 (6)
SS	28 (17)	30.5 (12)	29.5 (10)	31 (11)	36.5 (3)	41 (8)	47 (4)	44.5 (1)
LL	43.5 (25)	48 (16)	45 (14)	47 (7)	56 (4)	56.5 (1)	67.5 (3)	67 (10)
PI	45 (20)		46 (20)	47 (10)	47.5 (7)			

Table 3. Sagittal parameters-degrees, median and range, before and after surgery on lumbar disc hernia. Patients sub-grouped according to the Roussouly classi ication.

Discussion

The key finding of this study is that, compared to a comparable normal group, the majority (75%) of young adolescents presenting for LDH that required surgery had a low PI and a signi icantly lower LL. In contrast to a normal, unaffected comparable group, the proportion of the current research cohort was skewed towards type 1 (25%) or type 2 (50%) (global thoracolumbar kyphosis with a short hyper-

lordotic section and lat back respectively). In conclusion, adolescents with LDH were more than twice as likely to have a very low LL as the overall group (Figures 1 and 2).

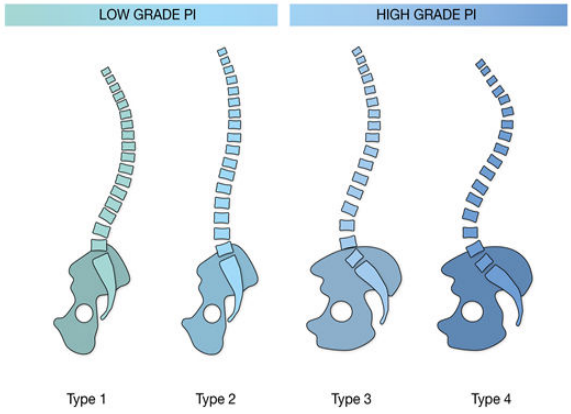

Figure 1. Sagittal alignment according to Roussouly et al. The spinal sagittal alignment grouped into 4 sub-groups based on their pelvic incidence and lumbar lordosis.

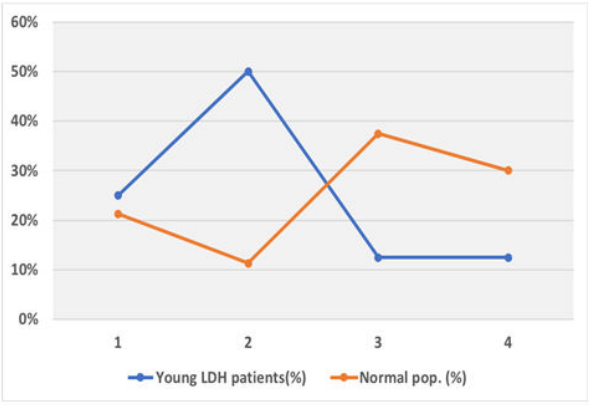

Figure 2. Observed group *vs.* a normal adolescent population, classified and divided into 4 subgroups.

The two lowest levels of the lumbar spine were the sites of all operations, which is consistent with major epidemiological research where more than 97% of LDH surgeries were conducted at these two lumbar levels.

The sagittal profile in these patients appears to be a risk factor for the development of LDH in this adolescent population rather than being brought on by momentary pain or muscular spasm. It is also in line with other research showing that early disc degeneration is linked to poor LL spinal morphology. Due to a number of factors, most notably the absence of lordosis in the lower lumbar spine, the type 1 or type 2 spinal sagittal alignment may predispose these individuals to LDH. Our cohort of young LDH patients revealed that the flat LL alters the vertical stress distribution towards the disc complex, potentially jeopardising the mechanical integrity of the disc.

Additional support for this idea comes from other studies that look at the prevalence of lumbar disc degeneration and LDH in physically active young adults and adolescents playing sports with high vertical loads. The patients in the study had an average age of 18.3 (range, 14-24) at the time of surgery. More study should be focused on evaluating the development of LL and skeletal maturity in early adolescents with spine and back pain issues because a flat back sagittal profile in adolescence appears to be a substantial risk factor for developing an LDH.

Conclusion

In conclusion, this study demonstrates that young patients with LDH who require surgery have a skewed sagittal spinal alignment relative to a normal population cohort and that the disc herniation condition itself has no effect on or alters this alignment. Roussouly types 1 or 2 should be viewed as a risk factor for the development of LDH in this cohort because they are significantly overrepresented in our analysis of young patients presenting for surgery. These results lend support to the idea that even young people with low LL who do not have other spinal degenerative alterations are more likely to experience lumbar disc degeneration and LDH due to increased loads placed on the anterior section of the spinal column.

Strengths

This is the first study in the literature to assess the sagittal profile in children with surgically repairable lumbar disc herniations. In order to assess changes that occurred after surgery and recovery, we also assessed the sagittal profile post-surgery.

Limitations

The current study has some limitations, such as the small number of young LDH patients; nonetheless, due to the rarity of this illness in this age group, large sample sizes are challenging to obtain. The study's second flaw is that it only examines those with chronic back or radicular pain (sciatica) that necessitates surgery, leaving out patients who are mostly receiving conservative treatments. In contrast to more acute onset pain, which has been shown to produce pain-induced scoliosis with a post-operative reversal and return to proper sagittal alignment, it is also possible that the relatively long duration of pre-operative pain in the investigated group does not cause any acute changes in the sagittal profile.

Ethical Considerations

The Sahlgrenska academy, Gothenburg university, Gothenburg, Sweden (ID number: 753-17) regional ethical review board granted ethical approval. All study participants gave informed consent before having erect radiographs taken as part of a customary pre- and post-operative clinical protocol. All patient data has been made anonymous. The project was approved by the regional IRB.

Acknowledgement

The authors also acknowledge the statistical support provided by Christer Johansson, a medical statistician at OrigoVerus AB in Gothenburg, Sweden. According to the ALF agreement (ID number 238801), which was signed between the Swedish government and the county governments, this activity was funded by grants from the Swedish state. The Sahlgrenska academy provided the time and materials to support the research, for which the authors are grateful.

Authors Contribution

Conception and design: All authors

Administrative support: HB, AB

Provision of study materials and patients: JB, HB, AB, OW

Collection and assembly of data: JB, AB, OW

Data analysis and interpretation: JB, AB, OW

Manuscript writing: All authors

Final approval of manuscript: All authors

References

1. Barrey, Cedric, Jerome J, Olivier N and Pierre R. "Sagittal Balance of the Pelvis-Spine Complex and Lumbar Degenerative Diseases. A Comparative Study about 85 Cases." *Euro Spine J* 16 (2007): 1459-1467.
2. Torrie, PAG, McKay G, Byrne R and Morris SAC, et al. "The Influence of Lumbar Spinal Subtype on Lumbar Intervertebral Disc Degeneration in Young and Middle-Aged Adults." *Spine Deform* 3 (2015): 172-179.
3. Menezes-Reis, Rafael, Gustavo PB, Vitor FD and Carlos FP, et al. "Association between Lumbar Spine Sagittal Alignment and L4-L5 Disc Degeneration among Asymptomatic Young Adults." *Spine* 41 (2016): E1081-E1087.
4. Roussouly, Pierre and Joao LP. "Sagittal Parameters of The Spine: Biomechanical Approach." *Euro Spine J* 20 (2011): 578.
5. Endo, Kenji, Hidekazu S, Hidetoshi T and Yupeng K, et al. "Sagittal Spinal Alignment in Patients with Lumbar Disc Herniation." *Euro Spine J* 19 (2010): 435-438.
6. Liang, Chen, Jianmin S, Xingang C and Zhensong J, et al. "Spinal Sagittal Imbalance in Patients with Lumbar Disc Herniation: Its Spinopelvic Characteristics, Strength Changes of the Spinal Musculature and Natural History after Lumbar Discectomy." *BMC Musculoskelet Disord* 17 (2016): 1-8.
7. Vialle, Raphael, Nicolas L, Ludovic R and Alexandre T, et al. "Radiographic Analysis of the Sagittal Alignment and Balance of the Spine in Asymptomatic Subjects." *JBJS* 87 (2005): 260-267.
8. Stromqvist, Fredrik, Bjorn S, Bo J and Paul G, et al. "Predictive Outcome Factors in the Young Patient Treated with Lumbar Disc Herniation Surgery." *J Neurosurg Spine* 25 (2016): 448-455.
9. Stromqvist, Fredrik, Bjorn S, Bo J and Magnus KK. "The Outcome of Lumbar Disc Herniation Surgery is Worse in Old Adults than in Young Adults: A Study of 14,090 Individuals in the Swedish Spine Surgery Register (SweSpine)." *Acta Ortho* 87 (2016): 516-521.
10. Lavelle, William F, Aaron B, Robert M and Randal R, et al. "Pediatric Disk Herniation." *J Am Acad Orthoc Surg* 19 (2011): 649-656.
11. Dang, Lei and Zhongjun Liu. "A Review of Current Treatment for Lumbar Disc Herniation in Children and Adolescents." *Euro Spine J* 19 (2010): 205-214.
12. Jackson, Roger P and Anne CM. "Radiographic Analysis of Sagittal Plane Alignment and Balance in Standing Volunteers and Patients with Low Back Pain Matched for Age, Sex and Size. A Prospective Controlled Clinical Study." *Spine* 19 (1994): 1611-1618.
13. Marks, Michelle, Chriss S and Peter N. "Which Lateral Radiographic Positioning Technique Provides the Most Reliable and Functional Representation of a Patient's Sagittal Balance." *Spine* 34 (2009): 949-954.
14. Horton, William C, Courtney WB, Keith HB and Steven D, et al. "Is there an Optimal Patient Stance for Obtaining a Lateral 36" Radiograph: A Critical Comparison of Three Techniques." *Spine* 30 (2005): 427-433.
15. Laouissat, Fethi, Amer S, Martin G and Pierre R. "Classification of Normal Sagittal Spine Alignment: Refounding the Roussouly Classification." *Euro Spine J* 27 (2018): 2002-2011.

How to cite this article: Beck, Joel Mattias, Helena Brisby, Adad Baranto and Olof Westin. "Flat Lumbar Lordosis Spinal Alignment is Over Represented in Young Individuals with Symptomatic Lumbar Disc Herniation." *J Spine* 12 (2023): 594.