The Correlation Between Facet Joint Parameters and the Location of Lumbar Disc Herniation in the Young Population

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Research Article

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Abstract

Background: Facet joint parameters have been discussed as substantial factors in the development of LDH. However, the correlation between facet joint parameters and the location of LDH in the corresponding segment is still unclear. The objective of this study was to demonstrate a clearly relationship between facet orientation (FO), facet tropism (FT) and lumbar disc herniation (LDH) in young individuals.

Methods: Between June 2017 and December 2019, 529 patients having single-level LDH (L4-5 or L5-S1) between 18 and 35 years old with a less than 2 years clinical history were included. Another 122 age-matched patients with no LDH were enrolled as the control group (N-LDH group). Based on the location of herniation, cases in LDH group were divided into three groups (LDH_L, LDH_R, and LDH_M). We investigated the correlation between facet joint parameters and the location of LDH.

Results: The FO_A in L4-5 and L5-S1 level were significantly lower while FT were higher in LDH group than N-LDH group respectively. In terms of the correlation between the facet joint parameters and the location of LDH, the level of LDH, the FO_L, FO_R, and FT were significantly varied among the three groups. There is a significant association between the different location of LDH and different FO of bilateral facet joints in L4-5 while not in L5-S1 level.

Conclusion: The facet joint parameters abnormality have an significant association with the development of LDH. Young individuals with higher FT and/or lower FO should be paid more attention to preventing the occurrence of LDH. There was more location of IVD herniated on the ipsilateral location with lower FO of facet joint when FT existed in L4-5 level.

1. Introduction

Lumbar disc herniation (LDH) is one of the more common spinal diseases caused by the degeneration and the displacement of nucleus pulposus or annulus fibrosis beyond the intervertebral disc space. As LDH is considered a significant health care problem involving multifactorial interactions, numerous studies have been performed to identify the risk factors. Previous etiologic studies have focused on environmental risk factors, such as sex, age, height, smoking habits, region, occupational factors, and so on [1,2].

Both sides of facet joints and corresponding intervertebral discs (IVD) form a three-joint complex. As an important part of the three-joint complex in the posterior area of the spinal column, facet joints have a significant role in providing stability to the spine and controlling motion in six degrees of freedom under the complex loading of the spine. Facet orientation (FO) and facet tropism (FT) are two important structural parameters of lumbar facet joint. Our previous studies showed that FT and FO were independent risk factors for recurrent LDH and chronic LBP, and they may play a more important role in the pathogenesis [3–5]. There are numerous studies regarding the relationship between facet joint parameters and LDH [6–8]. Asymmetrical facet joints are considered to be of importance as a cause of LDH by some authorities, while others report that FT has no relevance. Previous studies have found that FO and FT significantly influence the biomechanics of the corresponding facet joints and IVD [9]. FT may lead to the asymmetry of the bearing stress of the IVD on either side of the facet joint. So, is there a correlation between the different FO of bilateral facet joints and the location of LDH in the corresponding segment? There has been no relevant data on studies investigated the issue in the literature.

LDH is a common disorder among adults, with reported lifetime occurrence as high as 40%. Although the true frequency of this condition in children and adolescents is not precisely defined, it is generally believed to be much lower than that in adults. Based on the previous studies, the age should be considered an important factor which influences the study results of correlation between facet joint parameters and LDH. Because LDH of older patients is normally caused by long-term accumulated degeneration of lumbar spine, by contrast, the causes of LDH in younger patients are diverse including trauma, familial predisposition, obesity and degeneration. In order to eliminate the influence of age, we selected the young population between 18 and 35 years old in this study. In the present study, we attempt to determine whether there is an association between facet joint parameters and the occurrence of LDH at the motion segment in the young population. In addition, an association between facet joint parameters and the location of LDH in the corresponding segment was also investigated. To the best of our knowledge, the study is the first report to focus specifically on the correlation between facet joint parameters and the location of LDH in the corresponding segment.

2. Materials And Methods

2.1 Patient Population

This was a retrospective clinical study. From June 2017 to December 2019, 529 patients having single-level LDH (L4-5 or L5-S1) between 18 and 35 years old with a less than 2 years clinical history at our institution were included in this study. These patients had been referred to our institution for diagnostic evaluation and treatment of LDH, and had undergone computed tomography (CT) of lumbar spine. In addition, 122 patients with digestive system diseases between 18 and 35 years old who underwent abdominal CT scanning and hadn't LDH were also included as a control group in this study. All the patients were divided into a LDH group (LDH group) and a non-LDH group (N-LDH group) in this study. Patients with recurrent LDH, far lateral LDH, calcified LDH, previous spinal surgery or trauma, inflammatory disease, spondylolisthesis, myopathy, degenerative lumbar scoliosis, Paget's disease or spinal metastasis, were excluded from this study. All the patients and relatives gave informed approval to participate in this study. Finally, a total of 651 patients (529 in LDH group and 122 in N-LDH group) were deemed eligible for this study. There were 367 males and 284 females with a mean age of 29.9 years.

2.2 Data collection and outcome evaluations

All patients' clinical data were collected through the hospital records. We recorded their clinical parameters [gender, age, body mass index (BMI), current smoking, alcohol, occupation, trauma history], and facet joint parameters (FO and FT). Facet joint parameters were measured by using a computer-aided design image tool in the axial section of the CT images that were parallel to the endplate by using the method described by Li et al. and Noren et al. [3,4,10] FO is defined as the angle of the facet joints in the transverse plane relative to the sagittal plane. FT refers to asymmetry of the left and right vertebral facet joint angles, with one posing a more sagittal orientation than the other. The angle between the midsagittal line and facet joint line was measured for each side of the lumbar spine vertebral body (Fig. 1). In order to facilitate the analysis, FO_L and FO_R was designated as the angle of the left and right facet joint respectively. $FO_{L>R}$ was designated as the FO_L was greater than FO_R. FO_A was designated as the average of FO_L and FO_R. FT was designated by taking the absolute value of the difference between each side's FO.

Among the LDH group, the level of herniation was L4-5 in 380 cases (71.83%), and L5-S1 in 149 cases (28.17%). The location of herniation was left side in 234 cases (44.23%), right side in 207 cases (39.13%), and middle in 88 cases (16.64%). Based on the location of herniation, cases of each level in LDH group were divided into three groups consisting of left side protrusion (LDH_L), right side protrusion (LDH_R), and utterly central protrusion (LDH_M).

We measured the FO_L and FO_R of both L4-5 and L5-S1 levels in the LDH group and N-LDH group. In order to avoid measurement errors, a reading protocol for evaluation of FO and FT based on the above measuring method was acquired. By using this protocol, two experienced clinical doctors analyzed the selected axial images. They were required to do the measurements independently without knowledge of the patients' group and the object of our study. We selected the intraclass correlation coefficient to identify the reliability of 2 groups of the FO of facet joints and the location of herniation measured by the 2 observers. The average degree of the 2 observers' data was accepted for the study analysis. The intraclass correlation coefficient was found to be 0.973, which meant that there was a similarity in the facet joint parameters measurement between the two observers. Two typical case of LDH was shown as Figs. 2 and 3.

2.3 Statistical analysis

The Statistical Package for Social Sciences software for Windows (Ver. 17.0, SPSS Inc, Chicago, IL) was used for the data analysis. Because all of the continuous variables did not conform to the normal distribution, these continuous variables data were expressed as median (25th percentile, 75th percentile), whereas categorical variables data were expressed as counts (percentages). Continuous variables were compared using a Mann-Whitney U test or Kruskal-Wallis H test. Categorical variables data between two or more groups were compared by the Pearson $\chi 2$ test. All of the above analysis and tests were with a *p*-value of < 0.05 considered statistically significant.

3. Results

Firstly, we evaluated the association between FO, FT and LDH. The results of the correlational analysis among two groups (LDH group and N-LDH group) are presented (Table.1). In term of demographic data (gender, age, BMI, current smoking, alcohol, occupation, and trauma history), no significant difference was found between the two groups except gender. Compared to N-LDH group, male gender was statistically predominant in the LDH group ($p = 0.010$). In term of facet joint parameters, the FO_A at L4-5 level [43 (40.5, 46) vs. 45.5 (39, 51.5), $p = 0.005$], and L5-S1 level [45.5 (44, 47.5) vs. 51 (45.5, 56.5), $p < 0.001$] were significantly lower in LDH group than N-LDH group. The FT at L4-5 level [3 (2, 4) vs. 2 (1, 4), $p < 0.001$], and L5-S1 level [3 (2, 5) vs. 2 (1, 3), $p = 0.002$] were significantly higher in LDH group than N-LDH group.

Secondly, we investigated the correlation between the different FO of bilateral facet joints and the location of LDH. In term of demographic data (gender, age, BMI, current smoking, alcohol, occupation, and trauma history), no significant difference was found among the LDH_M, LDH_R and LDH_L group ($p > 0.05$). However, the level of LDH ($p = 0.042$), FO_L ($p = 0.002$), FO_R ($p < 0.001$), and FT ($p < 0.001$) were statistically varied among the three groups (Table.2). Based on the stratified analysis of different LDH level, the amount and percentages of different locations of LDH in L4-5 and L5-S1 level with $FO_{L>R}$, $FO_{L<R}$ and $FO_{L=R}$ were calculated respectively. Then the Pearson's 3×3 contingency table $\chi 2$ tests have proceeded (Table.3). There is a significant association between the different locations of LDH and different FO of bilateral facet joints in L4-5 level ($p < 0.001$) while not in L5-S1 level ($p = 0.567$). Then, the Pearson's 2×2 contingency table $\chi 2$ tests have proceeded with the cases characterized LDH_M or FT = 0 ($FO_{L=R}$) removed in L4-5 level (Table.4). It is showed $FO_{L<R}$ was in 112 of 148 (75.7%) cases in LDH_L compared with $FO_{L>R}$ was in 100 of 146 (68.5%) cases in LDH_R ($p < 0.001$).

Table 1
The demographics of the LDH and N-LDH groups

Variable	**LDH (n = 529)**	**N-LDH (n = 122)**	***P***
Gender (female: male)	218:311	66:56	0.010*
Age, (years)	32 (26, 34)	31 (28, 33)	0.278
BMI, (kg/m^2)	22.72 (20.66, 24.51)	23.06 (20.99, 25.25)	0.671
Current smoking, n (%)	86 (16.26%)	22 (18.03%)	0.635
Alcohol, n (%)	61 (13.10%)	17 (13.93%)	0.470
Occupation, n (%)			0.420
Worker	269 (50.85%)	55 (45.08%)	
Student	181 (34.22%)	44 (36.07%)	
Office staff	79 (14.93%)	23 (18.85%)	
Trauma history, n (%)	43 (8.13%)	9 (7.38%)	0.783
Level of LDH, n (%)			
L4-5	380 (71.83%)	-	
L5-S1	149 (28.17%)	-	
FO_A, (°)			
L4-5	43 (40.5, 46)	45.5 (39, 51.5)	0.005*
L5-S1	45.5 (44, 47.5)	51 (45.5, 56.5)	< 0.001*
FT, (°)			
L4-5	3 (2, 4)	2 (1, 4)	< 0.001*
L5-S1	3 (2, 5)	2 (1, 3)	0.002*

* Statistical significance was achieved when $p < 0.05$.

BMI, body-mass index; FO, facet orientation; FT, facet tropism; LDH, lumbar disc herniation; N-LDH, non-LDH; FO_A, the average FO of bilateral facet joints.

Table 2
The demographics of LDH_L, LDH_R, and LDH_M groups

Variable	**LDH_L (n = 234)**	**LDH_R (n = 207)**	**LDH_M (n = 88)**	***P***
Gender (female: male)	92:142	87:120	39:49	0.686
Age, (years)	32 (35.25, 34)	33 (26, 34)	31.5 (25.75, 34)	0.612
BMI, (kg/m^2)	22.79 (22.66, 24.79)	22.66 (20.53, 24.45)	22.54 (20.95, 24.05)	0.729
Current smoking, n (%)	36 (15.38%)	36 (17.39%)	14 (15.91%)	0.846
Alcohol, n (%)	37 (15.81%)	31 (14.98%)	15 (17.05%)	0.903
Occupation, n (%)				0.335
Worker	120 (51.28%)	103 (49.76%)	46 (52.27%)	
Student	42 (17.95%)	28 (13.53%)	9 (10.23%)	
Office staff	72 (30.77%)	76 (36.71%)	33 (37.50%)	
Trauma history, n (%)	21 (8.97%)	11 (5.31%)	12 (13.64%)	0.054
Level of LDH, n (%)				0.042
L4-5	164 (70.09%)	160 (77.29%)	56 (63.64%)	
L5-S1	70 (29.91%)	47 (22.71%)	32 (36.36%)	
FO, (°)				
FO_L	43 (40, 46)	45 (42, 47)	44.5 (41, 47)	0.002*
FO_R	45 (42, 48)	43 (41, 45)	44 (41.25, 47)	< 0.001*
FT, (°)	3 (2, 5)	3 (2, 4)	2 (0, 3.75)	< 0.001*

* Statistical significance was achieved when $p < 0.05$.

BMI, body-mass index; FO, facet orientation; FT, facet tropism; LDH, Lumbar disc herniation; L, left; R, right; M, median; FO_L, angle degree of the left facet joint; FO_R, angle degree of the right facet joint; LDH_L, left side protrusion of LDH; LDH_R, right side protrusion of LDH; LDH_M, utterly central protrusion of LDH.

Table 3
Relationship between the location of LDH and different FO of bilateral facet joints in L4-5 and L5-S1.

Variable	LDH_L (n = 234)	LDH_R (n = 207)	LDH_M (n = 88)	*P*
L4-5				
$FO_{L>R}$, n (%)	36 (21.95%)	100 (62.50%)	18 (32.14%)	
$FO_{L<R}$, n (%)	112 (68.29%)	46 (28.75%)	20 (35.71%)	
$FO_{L=R}$, n (%)	16 (9.76%)	14 (8.75%)	18 (32.14%)	
Total	164	160	56	< 0.001*
L5-S1				
$FO_{L>R}$, n (%)	30 (42.86)	25 (53.19%)	13 (40.63%)	
$FO_{L<R}$, n (%)	33 (47.14%)	18 (38.30%)	12 (37.50%)	
$FO_{L=R}$, n (%)	7 (10%)	4 (8.51%)	7 (21.88%)	
Total	70	47	32	0.567

* Statistical significance was achieved when $p < 0.05$.

LDH, lumbar disc herniation; FO, facet orientation; L, left; R, right; M, median; $FO_{L>R}$, the degree of FO_L higher than the degree of FO_R; $FO_{L<R}$, the degree of FO_R higher than the degree of FO_L; $FO_{L=R}$, the degree of FO_R equal with the degree of FO_L; LDH_L, left side protrusion of LDH; LDH_R, right side protrusion of LDH; LDH_M, utterly central protrusion of LDH.

Table 4
Relationship between the location of LDH and different FO of bilateral facet joints in L4-5.

Variable	LDH_L	LDH_R	*P*
$FO_{L>R}$, n (%)	36 (24.3%)	100 (68.5%)	
$FO_{L<R}$, n (%)	112 (75.7%)	46 (31.5%)	
Total	148	146	< 0.001*

* Statistical significance was achieved when $p < 0.05$.

LDH, lumbar intervertebral disc herniation; FO, facet orientation; L, left; R, right; $FO_{L>R}$, the degree of FO_L higher than the degree of FO_R; $FO_{L<R}$, the degree of FO_R higher than the degree of FO_L; LDH_L, left side protrusion of LDH; LDH_R, right side protrusion of LDH.

4. Discussion

4.1 The structure and function characteristics of IVD and facet joints

The IVD consists of three structurally various tissues: the annulus fibrosus (AF), the nucleus pulposus (NP), and two cartilaginous endplates that connect the disc with the adjacent vertebrae [11,12]. Throughout the lifetime, IVD undergoes a morphological and functional degenerate. LDH refers to a series of clinical symptoms caused by lumbar IVD degeneration and the herniation of nucleus pulposus, causing stimulation or compression of neighboring tissues. Among all cases, the highest incidence is at L4-5 and L5-S1 level with a prevalence of 95%.[13] LDH seriously threatens the health of the elderly and middle-aged. However, with the increasing pressure of daily life, the amount of activity and load on the spine have slowly increased, resulting in a younger trend of LDH, and there is an increasing number of patients with LDH in the youth population. Many youth patients having LDH do not have a long labour-time or previously trauma as a cause. If the relevant risk factors are intervened before the start of the disease, it is believed that the number of young patients with LDH will be significantly reduced.

The facet joints are the only synovial joints in the lumbar spine. Both sides of the facet joints and corresponding IVD form a three-joint complex. Several previous studies have considered that the two facet joints carry loads together with the IVD in the lumbar spine [3,14,15]. These studies showed that any deformity of one facet joint could affect the other and might cause asymmetric stress transmission to both facet joints and IVD, eventually leading to abnormal stress applications in regions of the IVD and facet joints. Facet joints are considered to share loads mainly during perpendicular motion of the lumbar spine and also protect the corresponding IVD from the excessive rotational motion [16]. The role of facet joint abnormality in the progression of LDH has been consistently studied during recent years [6–8,17–20]. Nevertheless, it remains unclear whether the changes of the facet joint geometrical parameter (FO and FT) act as the original morphological variations or it should be recognized as a result of reconstruction.

4.2 Relationship between FO, FT, and LDH in corresponding segment

In 1967, Farfan et al. [21] first proposed that asymmetry of the facet joints was a possible cause of LDH. Since then, various studies have yielded conflicting results concerning the association of facet joint parameters and the pathogenesis of LDH [22–26]. Van Schaik et al. [27] were the first to use CT scans to address this issue. They measured facet asymmetry in 100 patients with backache or sciatica or both, and found that there was an equal distribution of herniation to the side of both the more coronally oriented and more sagittally oriented facet joint. With greater degrees of asymmetry, there was a greater incidence of unilateral disc protrusion towards the side of the more coronally oriented joint. Park et al. [28] compared far lateral and posterolateral LDH and found that the differences in the degree of FT and disc degeneration might be considered a key factor in distinguishing the development of far lateral LDH from that of posterolateral LDH. Noren et al. [10] also concluded that facet joint asymmetry is a risk factor for the development of disc degeneration and herniation at all lumbar levels. Karacan et al. [29] observed that the patients with LDH had more asymmetry and sagittal orientation of the facet joints, and these alterations were more evident in the taller patients. More recently, Wang et al. [30] concluded that the measurement on different portions of facet joint may result in discrepancy on FT identification, and asymmetry between ipsilateral cephalad and caudad facet portions is also associated with L4-5 LDH in older patients.

In contrast, other scholars believe that the facet joint parameters and LDH do not correlate, and that lumbar facet joint asymmetry is a congenital structural manifestation, which is not due to age or degeneration [31–34]. Lee et al. [34] assessed 149 levels in 140 adolescents aged between 13 and 18 years and 119 levels in 111 adults aged between 40 and 49 years with LDH. They reported no significant difference in FT between the herniated and the normal discs in both the adolescent and adult groups, except at the L4-L5 level in the adults. They demonstrated that FT did not influence the development of herniation of the lumbar disc in either adolescents or adults. Cassidy et al.[33] found that there was no difference in the distribution of the more coronally or sagittally facing facet joints with respect to the side of lateral herniation. These results do not support the hypothesis that facet asymmetry is associated with LDH. Another study by Vanharanta et al. [31] also showed that there was no association between FT and lumbar disc diseases including herniation and degeneration. In the present study, we compared the FO and TO between the LDH and N-LDH groups, and found that there was a significant correlation between these two parameters and LDH at the L4-5 and L5-S1levels.

What is the reason for the inconsistency in the results of many studies on the association between facet joint parameters and LDH? A lot of variables could affect the conclusion of the study, such as the method used to measure the facet joint angle, the definition of FT, the type of control group, and so on. The age was also considered an important factor which influences the results of correlation between facet joint parameters and LDH. Because the changes of the facet joint parameters may be a result of LDH, especially in older patients with a long history of LDH, but this hypothesis needs to be verified. The IVD degeneration is more prevalent with increasing age. These degenerative changes such as decreased disc height index and increased sagittal range of motion further alter the biomechanics of the motion segment. As a result, it has been propagated that the facet joints are overloaded and become more susceptible to anterior shearing forces leading to facet joint remodeling and the development of LDH. At present, it is difficult to know whether the changes of the facet joint parameters act as the primary morphological variations or it should be recognized as a secondary reconstruction. In the present study, to eliminate the influence of age and prove the initial influence of facet joint parameters on IVD of the corresponding level, we limited patients' age between 18–35 years with the clinical history within two years which is distinguished from previous studies. Our study demonstrated that FO and FT are significantly associated with LDH at both L4-5 and L5-S1 levels. LDH group had a significantly greater degree of FT and lowered FO than N-LDH group. These differences were perceived to be statistically significant may be attributed to secondary changes because of changes in the facet parameters. It is to say LDH may be a result of facet joint parameters abnormality, especially in youth patients without a long labour-time or previous trauma. Lower FO and higher FT may be regarded to be risk factors for the development of LDH in the youth population.

Many biomechanical studies have found that facet joint parameters significantly influence the biomechanics of the corresponding segment [17,20,35–38]. Some scholars proposed that a more sagittal orientation of the facet joint promoted anterior gliding by reducing resistance to anterior shear forces [17]. In addition, when tropism was present, the motion segment was found to have a tendency to rotate towards the more oblique joint when axial loads were applied. This asymmetric axial rotation caused by tropism can place additional torsional loads on the IVDs which may plausibly contribute IVD or facet injury and degeneration. At the same time, the more sagittal orientation facet joint leaves angular motion as well as rotation to compensate for the other. Gradually, this rotational movement indirectly applies tensile stress on the annulus of the IVD, leading to protrude on the sagittal side [39]. In the present study, we found there is a significant correlation between the location of LDH and different FO of bilateral facet joints in L4-5 level. The IVD is more likely to protrude on the ipsilateral side where the FO is lower in L4-5 level. Our study raises the probability that the IVD has the inclination of herniated toward the sagittally oriented facet joint whenever there happened to be a combination of sagittal and coronal orientation in L4-5 level. However, a few previous studies have refuted this hypothesis [40]. This judgment still needs further confirmation with clinical and biomechanical research. Besides, our study demon strated that FT is more significantly related to LDH at the L4-5 level than L5-S1 level. Meanwhile, there is a significant association between the different locations of LDH and different FO of bilateral facet joints in L4-5 level while not in L5-S1 level. We speculated the reason is that the IVD in L5-S1 level below the iliac crest, the ilium could restrict segment movement, thus reduce the pressure and shear forces on the IVD.

4.3 limitations

There were several limitations concerning the current study. Firstly, this was a retrospective nonrandomized case-control study conveyed only on specific groups. Secondly, we had not selected sagittal balance, paraspinal muscle volume, pelvic and angular parameters, and other demographic features that may individually influence the development of LDH. Thirdly, our study was limited by geometrical considerations. The articular surface of the facet joint was viewed as a flat plane, which was not the most suitable representation of the real geometry. Our study did not take into account the complex three-dimensional geometry of the facet joints and their relationship with the lumbar spine degeneration. Future prospective, longitudinal, multi-modal imaging, and biomechanics studies are needed to further assess the feasibility and accuracy of this study.

5. Conclusions

The present study showed that the facet joint parameters (FO and FT) abnormality have an significant association with the development of LDH. Young individuals with higher FT and/or lower FO should be paid more attention to preventing the occurrence of LDH. In addition, there was more location of IVD herniated on the ipsilateral location with lower FO of facet joint in corresponding segment when FT existed in L4-5 level. The exact mechanism between facet joint parameters and LDH warrants further clinical and biomechanical investigation.

Abbreviations

FO: Facet orientation; FT: Facet tropism; LDH: lumbar disc herniation; IVD: Intervertebral discs; AF: Annulus fibrosus; NP: Nucleus pulposus.

Declarations

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Authors’ contributions

KS contributed to the study design, the writing of the paper, and drafting of the manuscript. LZH performed the surgeries and participated in the design of the study. YM, ZWT and STZ collected and analyzed the data. LZH and WNG reviewed and edited the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials

All data used and analyzed during this study are available from the corresponding author upon reasonable request.

Ethics approval and consent to participate

This research was approved by the ethics committee of the First Affiliated Hospital of Dalian Medical University. And agreement to participate was given by the participants. Because of the retrospective nature of the study, informed consent was waived.

Consent for publication

Written informed consent for publication of their clinical details and/or clinical images was obtained from the patient/parent/guardian/relative of the patient.

Competing interests

The authors declare that they have no competing interests.

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Figures

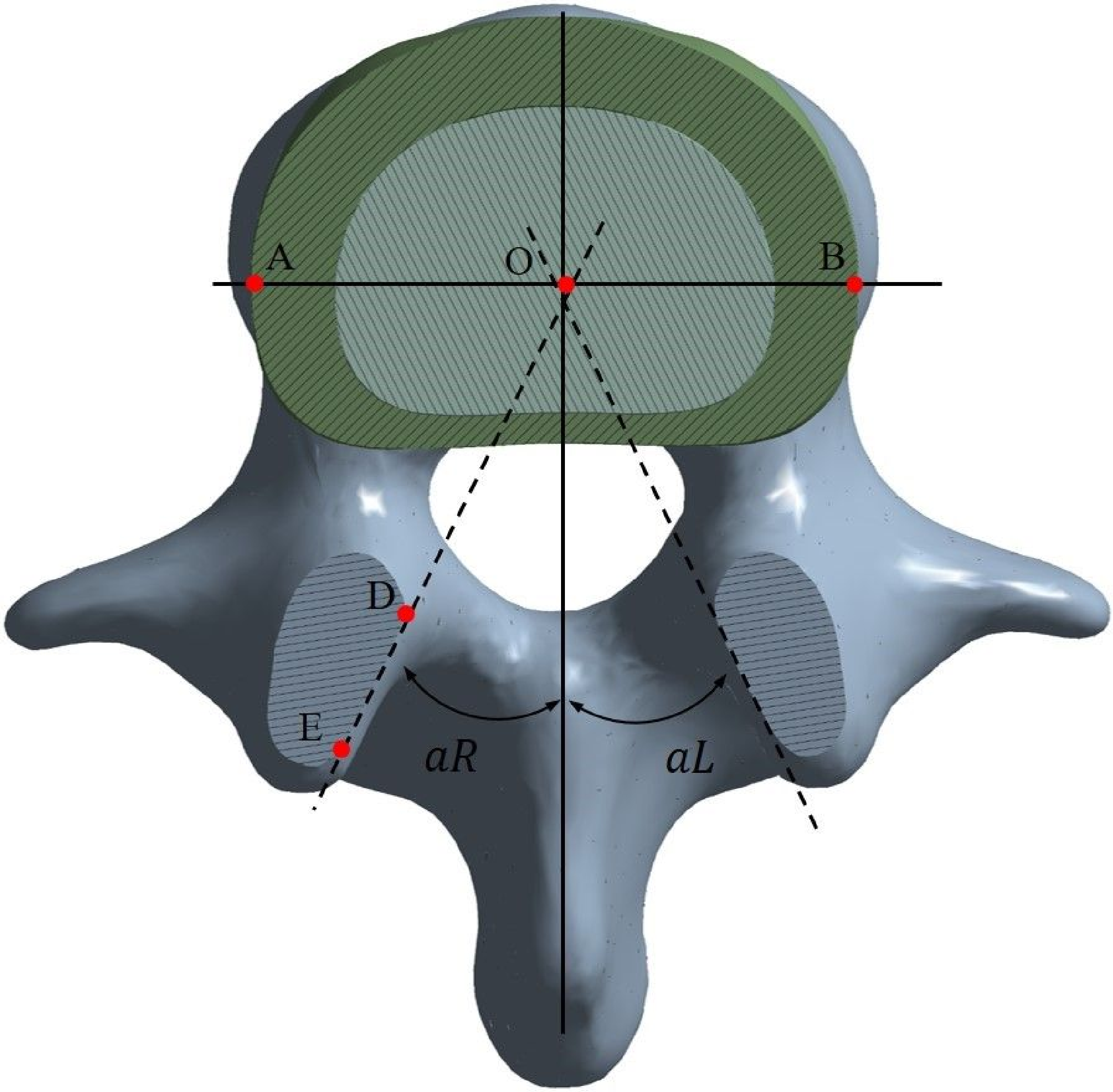

Figure 1

Diagram of the method used to measure the facet joint parameters (FO and FT). The facet line is drawn between the 2 peaks of each of the superior articular facets (D and E). The midline is drawn through the center of the lumbar vertebral body (O, AO = OB) and the middle point of the base of the spinous process. The angle between the midsagittal line and facet line was measured for each side of the lumbar vertebral body. FOR = aR, the right facet angle; FOL = aL, the left facet angle); FT = | aR - aL |, the absolute value of FOR and FOL.

Figure 2

A 35-year-old male with a 1-year history of left lower limb radiating pain. The CT image (axial view) of L4-5 level showed the herniation located on the left side, FOL = 32°, FOR = 41°, FT = 9°.

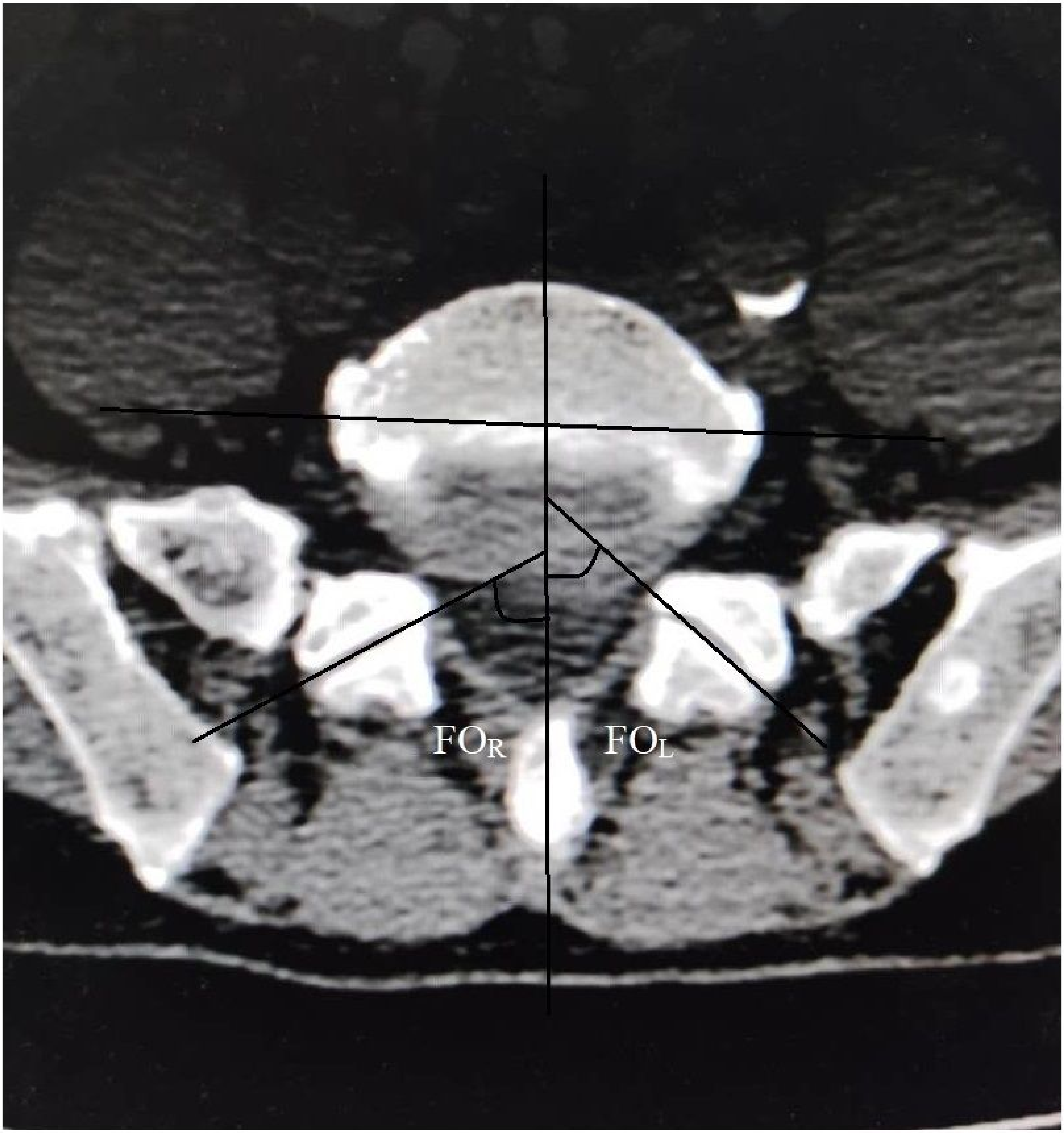

Figure 3

A 27-year-old male with a 2-year history of low back pain and left lower limb radiating pain. The CT image (axial view) of L5-S1 level showed the herniation located on the left side, FOL = 49°, FOR = 62°, FT = 13°.