

The correlation of axial rotation of the lumbar spine with degenerative disease of disk and lumbar end plates and apophyseal joint orientation

Leila Akhoundzadeh*, Alireza Mirfakhrai, Maryam Mozayan

Resident of Radiology, Department of Radiology, Faculty of Medical, Tabriz University of Medical Sciences, Tabriz, Iran.

*_Corresponding author: Leila Akhoundzadeh (l_akhoundzadeh@yahoo.com)

Abstract: Introduction: Decreased stability of spinal motion segments is the one of probable mechanisms of back pain. As yet, a few studies deliberated imaging characteristics of degenerative changes associated with spinal instability such as axial rotation and documented criteria's has not been suggested in the reference books. Attention to lumbar axial rotation and indirect signs suggesting it, is the important factor in selecting method of surgery and appeasement of patient's symptom. In this study, we determine relationship between axial rotation of lumbar vertebrae and degenerative changes of disk and end plates and apophyseal joint plane.

Materials and methods: We evaluated MR study of lumbosacral vertebrae of 709 patients, finally we found 50 patients with axial rotation. In addition, 50 patients without axial rotation random selected as control group. Disc appearance (with or without bulging or herniation), Disc hydration, Signal intensity of end plates, osteophyte formation and apophyseal joint plane are evaluated.

Results: case group include 29 females and 21 males with 39-61 years old age. In 50 patients with axial rotation, (72% of patients had clockwise axial rotation and 28% of patients had counterclockwise axial rotation. In case group, 0% of patients had complete hydration, 38% of patients had relative dehydration and 62% of patients had complete dehydration, 100% of patients had decreased height of disk, 12% of patients didn't have disk bulging and herniation, 22% of patients had disk bulging, 56% of patients had protrusion, 8% of patients had extrusion, 2% of patients had sequestration, 18% of patients had osteophyte formation, 34% of patients had normal signal of end plates, 30% of patients had type 1 signal changes, 26% of patients had type 2 signal changes, 10% of patients had type 3 signal changes. Also in 36 patients with clockwise axial rotation 100% of patients had decreased angle of right apophyseal joint plane and increased angle of left apophyseal joint plane. Also, in 14 patients with counterclockwise axial rotation 100% of patients had increased angle of right apophyseal joint plane and decreased angle of left apophyseal joint plane. In case group, in 36 patients with clockwise axial rotation 100% of patients had decreased left neuroforaminal AP diameter and 2% of patients had decreased right neuroforaminal AP diameter. In addition, in 14 patients with counterclockwise axial rotation, 100% of patients had decreased right neuroforaminal AP diameter and 6% of patients had decreased left neuroforaminal AP diameter.

Conclusion: Our study showed the correlation between axial rotation and disk dehydration, decreased height of disk, disk protrusion, types 1 and 2 signal changes of end plates, apophyseal plane angle changes, decreased neuroforaminal AP diameter at the same side of axial rotation ($p < 0.05$).

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Keywords: Axial Rotation of Lumbar Vertebrae, Disk Hydration, End Plates, Osteophyte Formation, Apophyseal Joint Plane.

1. Introduction

Back pain is considered as the second common patient's symptom (after headache) in the United States. Decreased stability of spinal motion segments is the one of probable mechanisms of low back pain (Mc Cormick, 1997; Pope and Panjabi, 1985; Hayes, 1989; Pope, 1992; Kirkaldy-Willis and Farfan, 1982; Schmidt, 1998 Nowicki, 1996; Donna, 2006). As yet, a few studies deliberated imaging characteristics of degenerative changes associated with spinal instability such as axial rotation and

documented criteria's has not been suggested in the reference books (Hayes, 1989; Donna, 2006). For radiologists, attention to Lumbar vertebral axial rotation and indirect signs suggesting it, is the important factor in selecting method of surgery and appeasement of patient's symptom. The patient with axial rotation put upon surgical vertebral fusion. Missed axial instability is the one probable cause of in appeasement patient's symptom after disk surgery (Donna, 2006; Victor, 1999; Victor, 2002). In this study, we determine relationship between axial

rotation of lumbar vertebrae and degenerative changes of disk and end plates and apophyseal joint plane.

2. Material and Methods

We evaluated MR study of lumbosacral vertebrae of 709 patients, finally we found 50 patients with axial rotation of lumbar vertebrae. In these patients, we evaluated type and severity of degenerative changes of disk and end plates and apophyseal joint plane.

In addition, 50 patients without axial rotation random selected as control group and we matched age and sex between control patients and patients with axial rotation of lumbosacral vertebrae.

Disc appearance is included in the one of these groups:

- 1- Normal
- 2- Bulged
- 3- Protruded
- 4- Extruded
- 5- Sequestrated

Disc hydration is included in the one of these groups:

- 1- Normal
- 2- Partial dehydration
- 3- Complete dehydration.

Signal intensity of end plates is included in the one of these groups:

- 1-Normal
- 2-Hypointense on T1W and hyperintense on T2W images
- 3-Hyperintense on T1W and hyperintense on T2W images
- 4- Hypointense on T1W and hyperintense on T2W images

Osteophyte formation and apophyseal joint plane are also evaluated.

3. Results

The patients with axial rotation (case group) include 29 females and 21 males with 39-61 years old age. In 50 patients with axial rotation, 36 patients (72% of patients) had clockwise axial rotation and 14 patients (28% of patients) had counterclockwise axial rotation.

In case group, 0 patient (0% of patients) had complete hydration, 19 patients (38% of patients) had relative dehydration and 31 patients (62% of patients) had complete dehydration and in control group 34 patient (68% of patients) had complete hydration, 13 patients (26% of patients) had relative dehydration and 3 patients (6% of patients) had complete dehydration.

In case group, 50 patients (100% of patients) had decreased height of disk and in control group 5

patients (10% of patients) had decreased height of disk.

In case group, 6 patients (12% of patients) didn't have disk bulging and herniation, 11 patients (22% of patients) had disk bulging, 28 patients (56% of patients) had protrusion, 4 patients (8% of patients) had extrusion, 1 patients (2% of patients) had sequestration and in control group 39 patients (78% of patients) didn't have disk bulging and herniation, 7 patients (14% of patients) had disk bulging, 4 patients (8% of patients) had protrusion, 0 patients (0% of patients) had extrusion, 0 patients (0% of patients) had sequestration.

In case group, 9 patients (18% of patients) had osteophyte formation and in control group seven patients (14% of patients) had osteophyte formation.

In case group, 17 patients (34% of patients) had normal signal of end plates, 15 patients (30% of patients) had type 1 signal changes, 13 patients (26% of patients) had type 2 signal changes, 5 patients (10% of patients) had type 3 signal changes and in control group 40 patients (80% of patients) had normal signal of end plates, 6 patients (12% of patients) had type 1 signal changes, 2 patients (4% of patients) had type 2 signal changes, 2 patients (4% of patients) had type 3 signal changes.

In case group, in 36 patients with clockwise axial rotation 36 patients (100% of patients) had decreased angle of right apophyseal joint plane and increased angle of left apophyseal joint plane. Also, in 14 patients with counterclockwise axial rotation 14 patients (100% of patients) had increased angle of right apophyseal joint plane and decreased angle of left apophyseal joint plane.

In control group, there is no significant alteration at apophyseal joint plane. In case group, in 36 patients with clockwise axial rotation 36 patients (100% of patients) had decreased left neuroforaminal AP diameter and one patient (2% of patients) had decreased right neuroforaminal AP diameter.

In addition, in 14 patients with counterclockwise axial rotation, 14 patients (100% of patients) had decreased right neuroforaminal AP diameter and three patients (6% of patients) had decreased left neuroforaminal AP diameter. In control group, four patients (8% of patients) had decreased neuroforaminal AP diameter.

All radiological finding in patients between two groups was shown in table 1.

4. Discussions

In this study, we determined correlation between axial rotation of lumbar vertebrae and degenerative changes of disk and end plates and apophyseal joint plane. A study, which has performed via Victor and colleagues at 1999 in United States,

has showed motion segments with concentric and transverse, specially radial tearing in annulus fibrosus of disk had more axial rotation (Victor, 1999). In comparison with its results, the results of our study

showed relationship between axial rotation and disk dehydration and disk protrusion. In addition, we showed relationship between axial rotation and decreased height of disk.

Table 1: Radiological finding in patients between two group

		Group		Total
		Control	Case	
Hydration	Normal	34	0	34
	Relative dehydration	13	19	32
	Complete dehydration	3	31	34
Disk height decrease	No	33	0	33
	Yes	17	50	67
Disk bulging	No	43	44	87
	Yes	7	6	13
Disk protrusion	No	46	16	62
	Yes	4	34	38
Disk extrusion	No	50	42	92
	Yes	0	8	8
Disk sequestration	No	50	42	92
	Yes	0	8	8
Osteophyte formation	No	43	41	84
	Yes	7	9	16
Endplate signal	Normal	41	17	58
	Low T1 High T2	6	8	14
	High T1 High T2	2	11	13
	LowT1 Low T2	1	14	15
Neural foramen AP diameter	Normal	46	0	46
	Decrease	4	50	54

In the similar study that has performed via Fujiwara and colleagues at December 2000, 110-lumbosacral motion segments in 44 patients were evaluated (Fujiwara, 2000). This study has determined relationship between disk degeneration and flexibility of motion segment. Its results have showed that axial rotation was impressed of disk degeneration and this correlation is similar between males and females. In addition, this study has showed subchondral sclerosis of facet joints because decreased range of motion of lumbar motion segments (Fujiwara, 2000). However, in our study we evaluated the relationship between axial rotations of lumbar vertebrae with apophyseal joint plane alteration.

The results of our study showed the correlation between axial rotation and alteration of facet joint plane angle. In addition, it did not show the significant relationship between axial rotation of lumbar vertebrae and osteophyte formation. Finally, we remembered, yet, there is no study that has evaluated the correlation between axial rotation of lumbar vertebrae and alteration of apophyseal joint

plane angle. In addition, yet, the relationship between axial rotations with signal changes of end plates and osteophyte formation too.

Also, the results of our study showed the significant correlation between axial rotation and decreased neuroforaminal AP diameter.

Conclusion:

Our study showed the correlation between axial rotation and disk dehydration, decreased height of disk, disk protrusion, types 1 and 2 signal changes of end plates, apophyseal plane angle changes, decreased neuroforaminal AP diameter at the same side of axial rotation ($p < 0.05$).

Also, this study did not show the correlation between axial rotation and disk bulging, extrusion and sequestration, type 3 signal changes of end plates, decreased neuroforaminal AP diameter at the opposite side of axial rotation, osteophyte formation.

Assessment of the results of our study and previous similar studies shows that the axial rotation of lumbar vertebrae, because of effect on connective tissue around the adjacent nerve root with in the

neural foramen , could be cause nerve root symptoms . Thus, further studies are needed to assess the correlation between the axial rotation of lumbar vertebrae and symptoms and signs of nerve root involvement.

Corresponding Author:

Dr. Leila Akhoundzadeh:

Emam Reza Hospital, Department of Radiology, Faculty of Medical, Tabriz University of Medical Sciences, Tabriz, Iran.

E-mail: l_akhoundzadeh@yahoo.com

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