



Original Article

Change in Radiating Leg Pain After Traffic Accidents in Patients With and Without Herniated Intervertebral Disc



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ABSTRACT

Background: The aim of this study was to assess the change in radiating leg pain after traffic accidents in patients with and without herniated intervertebral disc (HIVD) and improvement of radiating leg pain after traffic accidents.

Methods: This was an retrospective study of 188 patients. Patients who had been admitted to the Hospital of Korean Medicine with the complaint of radiating leg pain after traffic accidents, and who had undergone lumbar spine magnetic resonance imaging to determine the presence or absence of HIVD were observed from April to June 2016. We analyzed sex, age, length of admission, direction (to a single leg or to both legs) and locations, (medial, anterior, lateral or posterior side of the lower limb) of radiating leg pain, presence or absence of HIVD, and number, grade and position of HIVD. The Numeric Rating Scale (NRS) and Oswestry Disability Index (ODI) were used to evaluate the impact of radiating leg pain on patients.

Results: Radiating leg pain NRS score decreased significantly in both the HIVD group (from 6.12 ± 2.39 to 4.31 ± 1.87 , $p < 0.001$) and the no HIVD group (from 5.76 ± 1.64 to 3.85 ± 1.41 , $p < 0.001$). ODI score also decreased significantly in both groups (HIVD, from 44.67 ± 17.38 to 26.83 ± 13.18 ; no HIVD, from 39.24 ± 15.58 to $19.69 \pm 12.;$ both $p < 0.001$).

Conclusion: There was no significant change in radiating leg pain after traffic accidents in patients with and without HIVD and improvement of radiating leg pain after traffic accidents.

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Introduction

Traffic accidents are those in which cars, railways, ships or aircraft collide with each other or with other modes of transportation during operation, involve casualties or destruction of goods [1]. Today, as society continues to modernize, industry develops and amenities increases, the modes of transportations are becoming more diversified and the volume of traffic ever increasing. The incidence of traffic accidents is also increasing every year [2], as are the costs associated with the medical treatment of those injured. According to Korea Road Traffic Authority report on road traffic accidents, the number of traffic accidents in 2014 had increased by 3.8% to 223,552 compared to in 2013, and the numbers of wounded persons had increased by 2.7% to 337,497 [3]. According to the Health Insurance Review and

Assessment Service, for the auto insurance treatment entrusted judges for 2013-2015 increased by 79.2% to 6,835,568 in the second half of 2014, and the cost of judgement decisions increased by 87.9% to 72.6 billion won [4].

In 1999, the Automobile Liability Security Law was revised [5]; it became possible to claim automobile insurance to pay for Korean medicine treatment of injuries sustained in traffic accidents. Patients who do not require surgical treatment can be treated with Korean medicine therapies like acupuncture, moxibustion, herbal medicine, chuna therapy and cupping. The number of patients who go to Korean medicine institutions for treatment after traffic accidents is increasing due to great satisfaction with Korean conservative treatment [6].

Low back pain is one of the most common illnesses of contemporary people in daily life. Most cases of low back pain

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are caused by physical stress applied to the lumbar spine or lumbosacral lesions. Degenerative changes of the intervertebral disc and subsequent herniated intervertebral disc can easily lead to the development of low back pain [7]. Herniated intervertebral disc (HIVD) is caused by degenerative changes of the lumbar intervertebral disc, and can be defined as the dislocation of some or all of the nucleus pulposus and annulus fibrosus beyond the space between the vertebral bodies. If the nucleus pulposus and annulus fibrosus compress dura mater and nerve roots, they can induce neurological symptoms such as low back pain and radiating leg pain [8].

Symptoms of HIVD can be divided into pain and neurological symptoms. It has been estimated that 80% of the population will experience low back pain at least once in their lifetime, and 13–14% of the population will likely experience radiating leg pain [9]. Radiating leg pain is a major reason why patients with HIVD will visit a medical clinic. Thus, HIVD can cause great discomfort in daily life. Studies have been done on the mechanisms and properties of HIVD. Since Mixter et al initially suggested in 1932 that radiating leg pain is caused by compression of the nerve root due to herniated lumbar disc, alternative proposals have arisen that it may be caused by ischemia due to pressure rather than compression of the nerve root [10], or chemical irritation produced from the nucleus pulposus, causing a chemical reaction in the nerve root [11]. Nonetheless, a definite mechanism of radiating leg pain has not yet been established. In addition, the areas, expression patterns, natural histories, deterioration and mitigation factors of radiating leg pain in HIVD are varied, there was a lot of confusion in diagnosis and treatment of radiating leg pain.

Radiating leg pain due to HIVD can be similar to pain due to other spinal diseases such as foraminal indentation of the ventral dural sac, intervertebral foramen narrowing, epidural hemorrhage, abscess and tumor, hip and knee joint lesions, peroneal nerve palsy, and peripheral nerve injury can also be accompanied by radiating leg pain. Hence, differential diagnoses are needed.

Studies in Korea showed that treatment of low back pain and radiating leg pain caused by traffic accidents with Korean medicine such as pharmacopuncture and chuna therapy was effective [12,13]. In a study of patients diagnosed with HIVD, Korean medicine treatment was effective in relieving low back pain and radiating leg pain [14]. However, these studies only verified the significance of the effects of Korean medicine treatment. There is also a study on the relationship between radiating leg pain and radiologic findings in patients with low back pain [15], but it was limited to pain that manifested in daily life rather than as a result of traffic accidents. There are no studies on the symptoms and prognosis of radiating leg pain in patients admitted to Korean medicine institutions because of traffic accidents, nor any studies comparing the findings of radiological examinations with magnetic resonance imaging (MRI) scans.

The aim of this study was to assess the change in radiating leg pain after traffic accidents in patients with and without HIVD (as determined by MRI) and improvement of radiating leg pain after traffic accidents.

Materials and Methods

Patients

Of patients who had been admitted to the Hospital of Korean Medicine between April 1 and June 30, 2016 for lumbar spine MRI (Brivo MR355 1.5T and Signa HDe 1.5T MRI system; GE Healthcare, Chicago, IL, USA) due to persistent radiating leg pain after traffic accident, 200 patients were randomly selected. A total

of 188 patients were enrolled into the study after those with history of previous spinal surgery or herniated intervertebral disc were excluded (Fig. 1).

Methods

This was an observational study in which the medical records of the 188 hospitalized patients were studied. Data extracted from collected medical records included sex, age, length of admission, location and direction of radiating leg pain, presence or absence of HIVD, number, grade and position of HIVD, and Numeric Rating Scale (NRS) and Oswestry Disability Index (ODI) scores.

This observational study did not record patients' personally identifiable information, and was approved by the institutional review board of Jaseng Hospital of Korean Medicine (Jaseng 2016-08-004). Patients who participated in the study gave written consent at the time of admission agreeing to the use of academic materials.

Radiating leg pain

Radiating leg pain was categorized according to direction (to a single leg or to both legs) and location (medial, anterior, lateral or posterior side of the lower limb). If the patient complained of radiating leg pain in several areas, then the location of the most severe pain was recorded.

HIVD

Herniated discs were classified according to the degree of malposition at the border of the disc space [16]. If the patient had disc herniation at multiple sites, then the stage and location of the most severe degree of disc herniation were recorded.

Grade I (Bulging): Annulus fibrosus not torn, but disc displacement is more than 50%; divided into symmetric bulging and asymmetric bulging.

Grade II (Protrusion): Nucleus protruding inside of annulus fibrosus; distance between the displaced discs in both the axial and sagittal images is closer than the distance of base portions on the same plane.

Grade III (Extrusion): Nucleus extruding and penetrating the outside of the annulus fibrosus; distance between the displaced discs in both the axial and sagittal images is much farther than the distance of base portions on the same plane, or separated from the parent disc.

Grade IV (Sequestration): A part of the disc is dislocated as a free fragment, followed by rupture of the posterior longitudinal

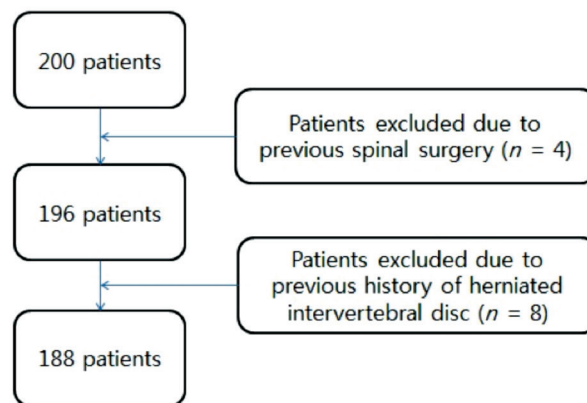


Fig. 1. Flowchart.

ligament.

NRS

Using the NRS, patients were asked to rate the intensity of radiating leg pain that they were experiencing, where 0 is no pain at all and 10 is the most severe pain they have ever felt [17]. Patients completed the NRS on the days of admission and discharge.

ODI

The ODI is used to rate the degree of disability. It was initially developed in 1980 and made up of 10 categories with six responses for each category (possible score 0, 1, 2, 3, 4, 5). The scores for the 10 categories are then summed and divided by the total score possible (which is 50 if all categories are answered), then multiplied by 100. The final result is a score that ranges from 0 to 100. A higher score indicates a greater degree of disability [18]. In this study, we used the Korean version of the ODI questionnaire, the validity and reliability of which have been verified by Jeon et al [19]. Patients completed the ODI on the days of admission and discharge.

Statistical analyses

Statistical analyses were performed using SPSS version 22.0 for Windows (IBM Corp., Armonk, NY, USA). Paired samples t-test was used to compare the improvement of radiating leg pain between the HIVD group and the no HIVD group. Values of $p < 0.05$ were considered to be statistically significant.

Results

Sex, age, and length of admission

A total of 188 patients were enrolled in the study. Table 1 shows the distribution by sex and age. There were more females (60%) than males (40%), and one-third of patients were aged 30–39 years.

The length of admission ranged from 0 to 30 days (Table 2); 44% of patients were hospitalized for 11–15 days.

Radiating leg pain and HIVD

Table 3 shows the direction and location of radiating leg pain. There were more patients with radiating pain in both legs (55%) than in a single leg (45%). The area where the highest number of patients felt the most severe pain was on the posterior side (39%).

Table 1. Sex and Age

		<i>n</i>	%
Sex	Male	76	40.4
	Female	112	59.6
Age(y)	10–19	5	2.7
	20–29	43	22.9
	30–39	62	33.0
	40–49	44	23.4
	50–59	17	9.0
	60–69	10	5.3
	≥ 70	7	3.7
Total		188	100

There were more patients with HIVD (65%) than without (35%), as diagnosed by lumbar spine MRI (Table 4). In both groups (HIVD and no HIVD), there were more females than males.

In the HIVD group, the area where the highest number of patients felt the most severe pain was on the posterior side (47%), while it was the anterior side in the no HIVD group (35%) (Table 5).

Table 2. Length of Admission

Length of admission (d)	<i>n</i>	%
0–5	2	1.1
6–10	47	25.0
11–15	83	44.1
16–20	31	16.5
21–25	22	11.7
26–30	3	1.6
Total	188	100

Table 3. Direction and Location Radiating Leg Pain

		<i>n</i>	%
Direction	To single leg	85	45.2
	To both legs	103	54.8
Location	Medial	13	7.0
	Anterior	45	24.0
	Lateral	57	30.2
	Posterior	73	38.8
Total		188	100

Table 4. Presence or Absence of Herniated Intervertebral Disc (HIVD)

	Male	Female	Total
With HIVD	51 (27.1)	72 (38.3)	123 (65.4)
No HIVD	25 (13.3)	40 (21.3)	65 (34.6)
Total	76 (40.4)	112 (59.6)	188 (100)

Data are presented as *n* (%).

Table 5. Location Radiating Leg Pain Presence or Absence of Herniated Intervertebral Disc (HIVD)

	Location	<i>n</i>	%
With HIVD	Medial	5	4.1
	Anterior	22	17.9
	Lateral	38	30.9
No HIVD	Posterior	58	47.1
	Medial	8	12.3
	Anterior	23	35.4
Total	Lateral	19	29.2
	Posterior	15	23.1
	Total	65	100

Among the 123 patients with HIVD, the majority had one or two herniated discs (77%), classified as Grade II (68%), at the L4/5 level (46%) (Table 6).

NRS and ODI

The radiating leg pain NRS score in patients with HIVD decreased significantly from 6.12 ± 2.39 on admission to 4.31 ± 1.87 at discharge ($p < 0.001$). The decrease in NRS score in patients with no HIVD was also significant, from 5.76 ± 1.64 on admission to 3.85 ± 1.41 at discharge ($p < 0.001$) (Table 7).

The ODI score in patients with HIVD decreased significantly from 44.67 ± 17.38 on admission to 26.83 ± 13.18 at discharge ($p < 0.001$). ODI score as also significantly decreased in patients with no HIVD, from 39.24 ± 15.58 on admission to 19.69 ± 12.10 at discharge ($p < 0.001$) (Table 7).

Discussion and Conclusion

The number of traffic accidents has been increasing with industrialization, and the incidence of traffic accidents in Korea is two to three times higher than that of major developed countries.

The management of injuries related to traffic accidents is being stand out as new medical problems [12]. Patients who have been involved in traffic accidents present with various clinical symptoms, but the most common are cervical and lumbar lesions due to trauma from abrupt acceleration and/or deceleration, or as a result of injuries sustained during the vulnerable time of boarding a mode of transportation [20].

Lumbago refers to pain in the lower back, mainly as a result of lower lumbar lesion. The lifetime prevalence of lumbago is reported to be 60–80%. The most common cause of low back pain accompanied by radiating leg pain is HIVD[7], which is when the lumbar intervertebral disc is locally extruded from the normal boundary of the intervertebral disc space [16].

HIVD can be classified into Grade I (Bulging), Grade II (Protrusion), Grade III (Extrusion) or Grade IV (Sequestration) according to the degree of lumbar disc herniation. In Grade I (Bulging), the annulus fibrosus symmetrically or asymmetrically pokes out 3 mm or more beyond the normal range of the intervertebral disc due to degenerative changes, but there is no tear of the annulus fibrosus; it is often not associated with low back pain or radiating leg pain. In Grade II (Protrusion), the nucleus pulposus tries to protrude through the medial annulus fibrosus but a part of the outer annulus fibrosus is not ruptured and the nucleus pulposus is not exposed to the outside of the annulus fibrosus. In Grade III (Extrusion), the nucleus pulposus rupture through the medial and also outer annulus fibrosus; but although a part of the nucleus pulposus extrude through the entire layer of the annulus fibrosus, the extruded nucleus pulposus remains connected to the core of the nucleus. In Grade IV (Sequestration), the extruded nucleus pulposus is completely disconnected and separated from the annulus fibrosus and compresses other nerve roots by movement above, below or outward within the spinal canal [5].

Radiating leg pain is a major factor that prompts patients with HIVD to visit a hospital. Studies have been done on the mechanisms and properties of HIVD.

There have been studies of low back pain and radiating leg pain caused by traffic accidents and studies of HIVD, but they have been conducted independently of each other. There are no studies that combine them. Although Kim et al [21] and Lee et al [22] have demonstrated the efficacy of Korean medicine treatment for low back pain and radiating leg pain after traffic accidents, their studies only included a few cases. Kim et al [15] did study the relationship between lower extremity radiologic findings and low back pain, but it was limited to pain that was experienced during daily life rather than as a result of traffic accident-related injuries. While there are observational studies pointing to the efficacy of Korean medicine treatment in patients with HIVD [23,24], there are no studies that clarify the correlation between traffic accidents and radiating leg pain.

We evaluated the improvement and prognosis of radiating leg pain due to traffic accidents in both patients with HIVD and in those without HIVD. The male:female sex ratio of the 188 patients included in the study was 1:1.48. One-third of patients were in their thirties.

Among the 123 patients with HIVD, the highest number of patients had herniated discs at the L4/5 level (46%) followed by L5/S1 (38%), which is consistent with the observation that most instances of HIVD occur at L4/5 and L5/S1, with only a 5–10% chance of occurrence above L4 [25].

NRS and ODI scores were also investigated to clarify the difference in improvement of radiating leg pain, according to the presence or absence of HIVD as diagnosed by lumbar spine MRI after traffic accident. We found that both NRS and ODI scores had

Table 6. Numbers, Grades and Position of Herniated Intervertebral Disc (HIVD)

		n	%
Number of herniated discs	1	55	44.7
	2	40	32.5
	3	23	18.7
	4	5	4.1
	5	0	0.0
Grade	I (Bulging)	30	24.4
	II (Protrusion)	84	68.3
	III (Extrusion)	9	7.3
	IV (Sequestration)	0	0.0
Position	L1/2	1	0.8
	L2/3	3	2.4
	L3/4	16	13.0
	L4/5	57	46.3
	L5/S1	46	37.5

Table 7. Radiating Leg Pain NRS Score and ODI Score Presence or Absence of Herniated Intervertebral Disc (HIVD)

	NRS		p*
	Admission	Discharge	
With HIVD	6.12 ± 2.39	4.31 ± 1.87	< 0.001
No HIVD	5.76 ± 1.64	3.85 ± 1.41	
	ODI		p*
	Admission	Discharge	
With HIVD	44.67 ± 17.38	26.83 ± 13.18	< 0.001
No HIVD	39.24 ± 15.58	19.69 ± 12.10	

*Paired samples t-test
NRS, Numeric Rating Scale; ODI, Oswestry Disability Index.

improved significantly at discharge when compared to at the time of admission in both groups (HIVD and no HIVD) of patients (both $p < 0.001$).

The results show that after Korean medicine treatment, patients had improved NRS and ODI scores regardless of whether or not they had HIVD to begin with. However, while both groups showed improvement in radiating leg pain, there were clear differences in the locations and positions of the leg pain according to whether patients had HIVD or not. Further studies are needed to elucidate the mechanism of radiating leg pain after traffic accidents so that management and treatment can be appropriately tailored to the patient.

This study was a retrospective chart review study. As there was no control group, a causal relationship between the presence or absence of HIVD and radiating leg pain after traffic accident cannot be demonstrated. In addition, no additional examinations were conducted in the no HIVD group to determine the objective causes of radiating leg pain, such as peroneal nerve palsy [26,27] or peripheral nerve injury [28]. In addition, as there was no long-term follow-up of patients post discharge, we have no information on prognoses. We hope that further studies are needed to be conducted to evaluate the presence of herniated intervertebral lumbar disc before traffic accidents but has not turned out as symptoms, and whether traffic accident was an immediate cause of HIVD. With an increasing number of Korean medicine institutions that can perform MRI examinations, there is opportunity for more research on traffic accident-related injuries and their diagnoses and treatment.

Conflicts of Interest

All authors have no conflicts of interest to declare.

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