의학박사 학위논문

Comparative Effectiveness of Lumbar Epidural Steroid Injections for Low Back Pain and Lumbar Radiculopathy Using Particulate versus Non-particulate Steroid: An Intra-individual Comparative Study

요추 통증 환자에서 입자성 또는 비 입자성 스테로이드를 이용한 경막외 스테로이드 요법의 치료 반응에 대한 상대 평가: 개인 내 비교 관찰 연구

2015 년 2 월

서울대학교 대학원

의과대학 임상의과학과

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A thesis of the Degree of Doctor of Philosophy

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February 2015.

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by
Ji Young Kim

A thesis submitted to the Department of Clinical Medical Sciences in partial fulfillment of the requirements for the Degree of Doctor of Philosophy at Seoul National University College of Medicine

February 2015

Approved by Thesis Committee:

Professor _____Chairman

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ABSTRACT

Purpose: To perform an intra-individual comparison for the effectiveness of lumbar epidural steroid injection (ESI) between injections using particulate (triamcinolone) and non-particulate (dexamethasone) steroid.

Materials and Methods: This retrospective cohort study was approved by the institutional review board, and the requirement for informed consent was waived. The study included 162 patients (M:F=60:102, mean age 66.3 years, range 27–90 years) who underwent lumbar ESI using dexamethasone (ESI_DEXA) from April 2013 to May 2013 and who had previously underwent lumbar ESI using triamcinolone (ESI_TRIAM) within one year. The degree of relative satisfaction was determined by phone call interview. The injection-free interval and injection frequency were analyzed by retrospective chart review. Subgroup analyses were also done according to the diagnosis, approach methods, the patients' ages and sex.

Results: Eighty-seven of 139 patients (62.6%) answered that the effect of ESI_TRIAM was better than that of ESI_DEXA

($p<0.01$). The injection-free interval of ESI_TRIAM (mean = 91.5 days) was significantly longer than that of ESI_DEXA (mean = 77.3 days, $p=0.01$). In the subgroup analyses, the patient group with HIVD, who underwent transforaminal ESI, under age 70 and female patients with relation of longer injection-free interval of ESI_TRIAM than ESI_DEXA were statistically significant ($p < 0.05$). Injection frequencies of ESI_TRIAM were less than those of ESI_DEXA in the patients with HIVD and who were under age 70 ($p<0.05$). Other factors were not significant.

Conclusions: The relative satisfaction with ESI_TRIAM was significantly better than that with ESI_DEXA in the same patient, and the injection-free interval after ESI_TRIAM was significantly longer than that after ESI_DEXA.

Keywords: Lumbar epidural injection, Steroid, particulate

Student number: 2013-30821

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LIST OF ABBREVIATIONS

ESI: epidural steroid injection

LBP: low back pain

ESI_TRIAM: lumbar epidural steroid injection using triamcinolone

ESI_DEXA: lumbar ESI using dexamethasone

first dexa date: the date of the initially performed the lumbar epidural steroid injection using dexamethasone

INTRODUCTION

Lumbar epidural steroid injection (ESI) is a commonly used intervention for low back pain (LBP) with radiculopathy [14; 17]. Lumbar radiculopathy is considered to be caused by inflammatory injury to the nerve roots in the condition of neural foraminal stenosis or herniated intervertebral disc [5]. Lumbar ESI localizes the steroid around the target nerve roots, thereby decreasing inflammation of affected nerve roots and reducing the pain [14; 17]. Therefore, the systemic side effects of the steroid are expected to decrease in this localized treatment. However, there have been several reports of serious complications of ESI, including spinal cord and brain embolic infarctions, especially caused by the particulate corticosteroids (e.g. triamcinolone) [8–11].

Although dexamethasone is the only drug with a clean safety record [18], there is a controversy about whether the effectiveness of dexamethasone is equal to that of triamcinolone. The suggested theory is that a non particulate soluble steroid is rapidly cleared from a target site, resulting in a shorter acting time and less effect [3; 6]. Although several studies[7; 13; 19]reported that there were no statistically

significant differences between particulate and non particulate steroids in the effects of cervical ESI, some studies(11, 12, 14) observed that the triamcinolone group exhibited somewhat greater improvement. All previous studies were comparison studies between different patient groups. However, there was a great deal of variability between individuals with respect to the relative effectiveness of and satisfaction with the treatment. Therefore, an intra-individual comparison of the efficacy and safety of lumbar ESI between injections using particulate and non particulate steroids in the same patient will have a great clinical impact. Because the use of triamcinolone for ESI has been forbidden in our country since March 2013, we were required to use a non particulate steroid such as dexamethasone for ESI. Therefore, the patients who had previously undergone lumbar ESI using triamcinolone (ESI_TRIAM) should have received lumbar ESI using a non particulate steroid since March2013.This circumstance facilitated a comparison study between two different drugs (triamcinolone vs. dexamethasone) in the same patient.

The purpose of this study was to perform an intra-individual comparison of the effectiveness of lumbar ESI

between injections using a particulate (triamcinolone) and non-particulate (dexamethasone) steroid.

MATERIALS AND METHODS

Patients

This retrospective cohort study was approved by the institutional review board, and the requirement for informed consent was waived. From April 2013 to May 2013, 654 lumbar ESIs were performed in our department. Indications of lumbar ESI in our department were (1) the presence of LBP and lumbar radiculopathy with or without claudication, (2) a failure of conservative treatment, and (3) evidence of nerve root compression demonstrated on cross-sectional imaging such as magnetic resonance imaging or computed tomography. To develop a study group of suitable cases in order to compare the efficacy of lumbar ESI between injections using triamcinolone and dexamethasone in the same individual, we used the following inclusion criteria: (1)individuals had undergone lumbar ESI using dexamethasone (ESI_DEXA) from April 2013 to May 2013; (2) individuals had previously undergone the same level of ESI within the previous one year via the same approach using triamcinolone; (3) individuals consented to participate in a phone call interview six months after the date of the initially performed ESI_DEXA (*first dexa date*).The

criterion of requiring a patient who had undergone ESI_TRIAM within one year was used to avoid a potential recall bias caused by a long-term follow-up interval between ESI_TRIAM and ESI_DEXA.

Among the patients, we excluded seven who had undergone the following in the period between the last ESI_TRIAM and the *first dexa date*: decompression surgery (n=3), vertebroplasty due to compression fracture (n=2), knee replacement surgery(n=1) and development of anaplstic anemia (n=1).Finally, our study included 162 patients (M: F = 60:102, mean age 66.3 years ± 13.1 [standard deviation], range 27-90 years) who had undergone ESI_DEXA via three different approaches: caudal (n=38, M:F= 13:25, mean age 70.7 years ± 9.2, range 51-87 years), interlaminar (n=50,M:F= 19:31, mean age 64.6 years ±12.8, range 27-90 years), and transforaminal (n=74, M:F= 28:46, mean age 65.18 years ±14.5, range 31-86 years)].

Lumbar ESI technique

All lumbar ESIs were performed by one of two radiologists with 10 years' and 5 years' experience,

respectively, in spine intervention. The procedure and its possible complications are explained to the patient, and informed consent for the lumbar ESI is obtained. Lumbar ESIs were performed via three different approaches to access the lumbar epidural space: interlaminar, transforaminal, and caudal. The appropriate lumbar approach of lumbar ESI for each patient was selected according to the patient's symptoms and the decision of the radiologists based on cross-sectional imaging findings and physical examinations. The patient was placed in the prone position on the fluoroscopy table. Under fluoroscopic guidance, a 22G spinal needle was advanced straight from the skin to the target object: the posterior epidural space through the interlaminar space for the interlaminar approach, the neural foramen underneath the pedicle for the transforaminal approach, and the midline cranial area of the sacral hiatus for the caudal approach. After the needle position was checked by fluoroscopy, about 1 mL of contrast material (Omnipaque 300 [IOHEXOL, 300 mg of iodine per milliliter]; Amersham Health, Princeton, NJ) was injected to confirm the accurate epidural location of the needle tip. Spot radiographs were obtained to document the distribution of the contrast material (Fig. 1).

From April 2013 to May 2013, all patients were given 10 mg (2 ml) of dexamethasone sodium phosphate (5 mg per milliliter; Choonwae Pharma Corporation, Seoul, Korea) as the injected steroid. Prior to March 2013, all patients were given 40 mg (1 ml) of triamcinolone acetonide suspension (Tamceton [40 mg per milliliter]; Hanall Pharmaceutical, Seoul, Korea) as the injected steroid for lumbar ESI.

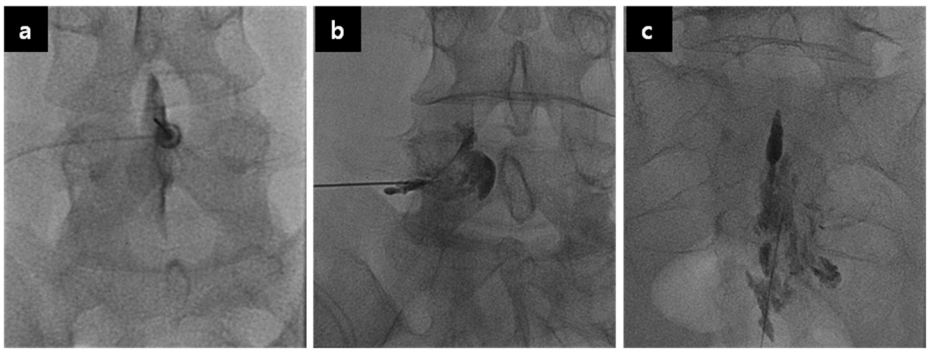

Figure 1. Spot radiographs in anteroposterior view after contrast media injection during lumbar epidural steroid injections via three different approaches to access the lumbar epidural space: (a) interlaminar, (b) transforaminal, and (c) caudal.

Phone call interview

Six months after the *first dexa date*, a phone call interview was conducted by one research assistant. To compare the patients' satisfaction with the two different drugs (triamcinolone vs. dexamethasone) used in the lumbar ESI, the degree of relative satisfaction was asked. For the statistical analysis, the degree of relative satisfaction results were converted to a numerical score: the effect of ESI_TRIAM was much better than ESI_DEXA = 5, better = 4, same as ESI_DEXA = 3,worse = 2, and much worse = 1.Twenty-three patients could not answer the questionnaire about relative satisfaction because of their lack of memory. Therefore, 139 patients were available for the analysis evaluating the relative satisfaction between the two drugs. An additional question was whether or not the additional ESI or the decompressive operations were performed in another hospital or department. Major complications including cerebrovascular accident, spinal cord injury, or other unexpected neurologic deficit were also evaluated.

Review of clinical data

A retrospective review of the patients' medical records was performed by one radiologist. Information regarding each patient's age, gender, the diagnosis of what caused the LBP or lumbar radiculopathy, the approach methods of the ESI, and the level of ESI were obtained by reviewing these records. The diagnoses of what caused the LBP or lumbar radiculopathy were classified as stenosis of the spinal canal and neural foramen due to spondylosis (with or without disc herniation) or herniated intervertebral disc (HIVD). Changes in the injection-free intervals, the possible predictive factor of the effectiveness of lumbar ESI between the two different drugs in the same patient, were determined. The injection-free interval for ESI_TRIAM was defined as the number of days between the last dates of the ESI_TRIAM and the *first dexa date*. The injection-free interval for ESI_DEXA was defined as the number of days between the *first dexa date* and the date of the additional ESI_DEXA. For the statistical analysis for the comparison of the injection-free intervals, a total of 79 patients were excluded according to the following criteria: 1) those who had no additional ESI_DEXA after the *first dexa date* (n=51)

during the six-month follow-up period because of the patient's refusal; 2) those who had a long injection-free interval for ESI_TRIAM of over six months (n=23), when applying the same criteria in ESI_TRIAM and ESI_DEXA, because the time duration for evaluating the injection-free interval of ESI_DEXA was six months;3)those who had undergone a decompressive operation before the additional ESI_DEXA (n=4), because the injection-free interval could not be determined; and4)those who had had an additional lumbar ESI in the outside the hospital before the additional ESI_DEXA(n=12),because the date and the approach of ESI were not clear. Eleven patients were included in both exclusion criteria for the comparison of the injection-free interval: ten for exclusion criteria 1) and 2), and one patient for exclusion criteria 2) and 4).

The additional injection frequencies of the two different drugs in the same patient were checked according to the number of injections using triamcinolone versus the number using dexamethasone, within six months of the *first dexa date*. Additional injection frequencies of ESI_TRIAM within six months were determined by the number of ESI_TRIAM injections during the six months just before the *first dexa date*.

Additional injection frequencies of ESI_DEXA within six months were determined by the number of ESI_DEXA injections during the six months after the *first dexa date*. The ESI performed at the *first dexa date* was not counted in the number of the additional injection frequencies of either ESI_TRIAM or ESI_DEXA, because it was a reference point. For the statistical analysis for the comparison of the injection frequencies, a total of 66patientswere excluded according to the following criteria: 1) those who had first visited our clinics for ESI_TRIAM more recently than six months before the *first dexa date* (n=48), because the time duration for evaluating the additional injection frequencies of ESI_TRIAM was less than six months for these patients;2) those who had undergone a decompressive operation within six months after the *first dexa date* (n=8),because the time duration for evaluating the additional injection frequencies of ESI_DEXA was less than six months; and 3) those who had received an additional lumbar ESI outside the hospital within six months after the *first dexa date*(n=18), because the number and approach of ESI were not clear. Eight patients were included in both exclusion criteria for the

comparison of the injection frequencies: three patients for exclusion criteria 1) and 2), and five patients for 1) and3).

In addition, we evaluated the proportion of the "earlier revisiting patients" after ESI _DEXA. We defined "earlier revisiting patients" to refer to patients who revisited the clinics sooner than one month after ESI _DEXA, due to severe pain and no improvement.

Subgroup analysis

We did the subgroup analyses to determine the differences between the variables according to the clinical and imaging diagnosis of what caused the LBP and lumbar radiculopathy in the patient(HIVD and stenosis), the approach methods of lumbar ESI (caudal, interlaminar, or transforaminal), the patients' ages (<70 years old, ≥70 years old), and the patients' sex (male or female).The relative satisfaction score, the injection-free intervals of ESI_TRIAM and ESI_DEXA, and the changes in additional injection frequencies within six months were evaluated for each subgroup.

Statistical Analysis

To evaluate the relative satisfaction between ESI_TRIAM and ESI_DEXA, one sample proportion test and one sample mean test were used. The paired t-test was used to compare the injection-free interval and the injection frequencies within six months between the two groups (ESI_TRIAM and ESI_DEXA).

The paired t-test was also used for subgroup analysis, to evaluate the differences in the injection-free intervals and the additional injection frequencies between the two groups (ESI_TRAM and ESI_DEXA) according to the diagnosis of what caused each patient's symptoms (HIVD and stenosis), the approach methods of lumbar ESI (caudal, interlaminar, or transforaminal), the patients' ages (<70 years old, ≥70 years old), and the patient's sex (male or female).

A p-value of less than .05 was considered to indicate a significant difference, and a 95% confidence interval (CI) was reported. For the statistical analysis, we used the Med-Calc for Windows software (version 8.0.0.1; MedCalc Software, Mariakerke, Belgium).

RESULTS

Table 1 summarizes the degree of relative satisfaction for ESI_TRIAM and ESI_DEXA. Eighty-seven of 139 patients (62.6%, 95% CI =54.6%-70.6%) answered that the effect of ESI_TRIAM was better than that of ESI_DEXA. Twenty-seven of 139 patients (19.4%) answered that the effects of ESI_TRIAM and ESI_DEXA were similar. Twenty-five of 139 patients (18.0%) answered that ESI_DEXA showed better results than ESI_TRIAM. The proportion of the patients who preferred ESI_TRIAM (62.6%, 95% CI =54.6%-70.6%) was significantly greater than the proportion of the patients who preferred ESI_DEXA (18.0%) ($p = 0.002$).

Table 1. Degree of Relative Satisfaction of ESI_TRIAM, Compared to ESI_DEXA

ESI_TRIAM >ESI_DEXA		ESI_TRIAM = ESI_DEXA	ESI_TRIAM <ESI_DEXA		Total
Much better	Better	Same	Worse	Much Worse	
30 (21.6)	57 (41.0)	27 (19.4)	24 (17.3)	1 (0.7)	139 (100)
87 (62.6)			25(18.0)		

Note.—Data are the numbers of patients, with the percentages in parentheses. The total number of patients in this analysis is 139, because 23 patients could not answer the questionnaire about relative satisfaction due to lack of memory.

Abbreviations.—ESI_TRIAM: lumbar ESI using triamcinolone; ESI_DEXA: lumbar ESI using dexamethasone

Table 2 summarizes differences in the injection-free intervals and the additional injection frequencies between ESI_TRIAM and ESI_DEXA. The injection-free interval of ESI_TRIAM (mean = 91.5 days, 95% CI = 84.05-98.95 days) was significantly longer than that of ESI_DEXA (mean = 77.29 days, 95% CI = 67.52-87.07 days, p = 0.01) (Fig.2).Twenty-six patients (26/83, 31.3%) experienced a longer injection-free interval with ESI_TRIAM, an interval of over 30 days, than that experienced with ESI_DEXA. Four patients underwent a decompressive operation, and twelve patients underwent an additional lumbar ESI outside the hospital before the second ESI_DEXA. With respect to the additional injection frequency during six months, the additional injection frequency of ESI_TRIAM (mean =1.11, 95% CI = 0.95-1.28) was less than that of ESI_DEXA (mean = 1.19, 95% CI = 0.98-1.39). However, the difference was not statistically significant (p = 0.48).

Table 2. Comparison of Injection-free Interval and Additional Injection Frequencies between ESI_TRIAM and ESI_DEXA

	ESI_TRIAM	ESI_DEXA	P-value
Injection-free Interval (days)	91.5 (84.05 to 98.95)	77.29 (67.52 to 87.07)	***p=0.01***
Additional Injection Frequency within Six Months	1.11 (0.95 to 1.28, range: 0–3)	1.19 (0.98 to 1.39, range: 0–4)	*p=0.48*

Note.—Data are the arithmetic mean of the injection-free interval period (days) and the additional injection frequencies, with the95% CI for the mean in parentheses.

Abbreviations.—ESI_TRIAM: lumbar ESI using triamcinolone; ESI_DEXA: lumbar ESI using dexamethasone

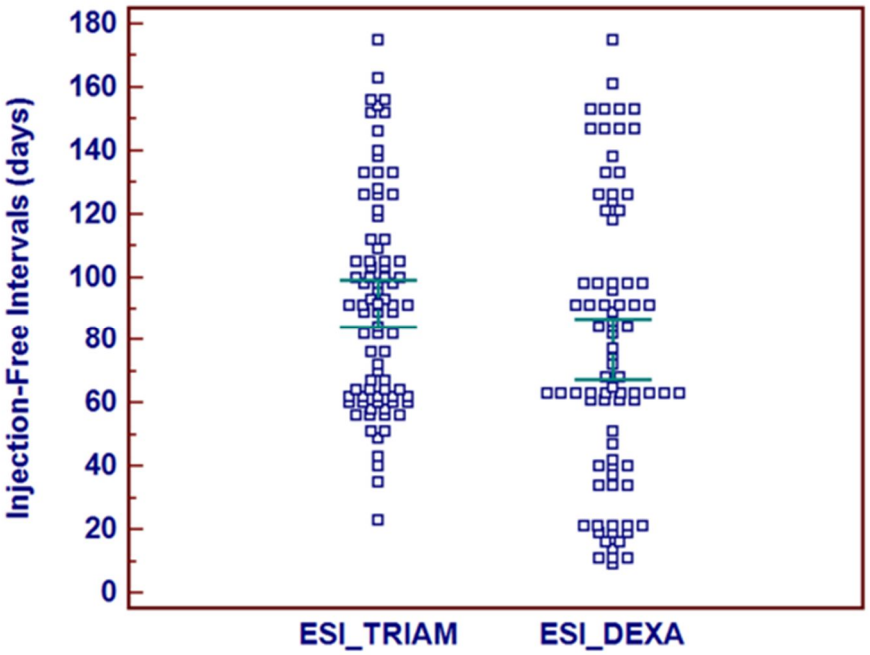

Figure 2. Graph shows the changes of injection-free intervals between lumbar epidural steroid injections using triamcinolone (ESI_TRIAM) and lumbar epidural steroid injections using dexamethasone (ESI_DEXA). (Error bars: 95% CI for mean)

Table 3 demonstrates the composition of patients who experienced treatment failure after the lumbar ESI_DEXA. The earlier revisiting patients after the *first dexa date* were nineteen (19/162, 12%; caudal: interlaminar: transforaminal = 1 [1/38, 3%]:7 [7/50, 14%]: 11 [11/74, 15%]). For these 19 earlier revisiting patients after ESI_DEXA, the range of the injection-free intervals since the ESI_TRIAM was from 60 days to 305 days (mean: 132.4 days, 95% CI=95.71-169.03). Among these earlier revisiting patients after ESI_DEXA, there was none who experienced a short injection-free interval after ESI_TRIAM of less than 60 days, and there were twelve patients (12/19, 63%) who experienced a long injection-free interval after ESI_TRIAM of over 90 days. Five patients (5/19, 26%) among the earlier revisiting patients experienced a long injection-free interval after ESI_TRIAM of over 180 days.

Eight of the 162 patients (5%) underwent a decompressive operation within the six-month follow-up period after the *first dexa date*, because the pain and the neurologic symptoms were aggravated. Two additional patients were recommended for the decompressive operation by orthopedic surgeons, but the operations were not performed during the six-month follow-up

period. The phone call interview revealed that 18 patients (18/162, 11%) experienced an additional lumbar ESI in the outside hospital, because they could not endure the LBP. There were no major complications requiring admission after the lumbar ESI.

Table 3. Patient Composition with respect to Treatment Failure of Lumbar ESI_DEXA within Six-month Follow-up after *first dexa date*

Earlier Revisiting Patients	**Decompressive Operation**	**Additional ESI outside hospital**	**Total**
19/162 (12%)	8/162 (5%)	18/162 (11%)	45/162 (28%)

Note. Data are the numbers of patients, with percentages in parentheses.

The results of subgroup analyses according to the diagnosis of what caused the LBP and lumbar radiculopathy, the approach methods, and the patient's ages and sex are provided in tables A1–A3. The proportion of patients who preferred ESI_TRIAM was greater than the proportion patients who preferred ESI_DEXA in all subgroups, in terms of relative satisfaction. With respect to the injection–free interval, four subgroups (subgroup 1: those for whom HIVD was the causal factor of the LBP or lumbar radiculopathy, p=0.02; subgroup 2: those who underwent lumbar ESI via the transforaminal approach, $p < 0.01$; subgroup 3: those who were younger than 70 years old, p = 0.04;and subgroup 4: female group, p = 0.01) show that the injection–free intervals after ESI_TRIAM (subgroup 1 = 105.17 days, 95% CI = 90.05–120.29; subgroup 2 = 89.38 days, 95% CI = 77.55–101.22; subgroup 3 = 97.11 days, 95% CI = 86.29–107.93; subgroup 4 = 92.78 days, 95% CI = 84.46–101.09) were significantly longer than those for ESI_DEXA (subgroup 1 = 78.58 days, 95% CI = 60.63–96.54; subgroup 2 = 63.68 days, 95% CI = 47.99–79.36; subgroup 3 = 79.13 days, 95% CI = 64.76–93.51; subgroup 4 = 75.74 days, 95% CI = 63.68–87.81). Two subgroups (subgroup 1:those for

whom HIVD was the causal factor of LBP or lumbar radiculopathy, $p<0.01$; subgroup 2: those who were younger than 70 years old, $p=0.03$) show that the injection frequency within six months after ESI_TRIAM (subgroup 1 = 0.92, 95% CI = 0.7-1.145; subgroup 2 = 1.02, 95% CI = 0.81-1.22 was significantly less than that after ESI_DEXA (subgroup 1 = 2.19, 95% CI = 1.80-2.59; subgroup 2 = 1.34 days, 95% CI = 1.05-1.63).

Table A1.Subgroup Analyses: Degree of Relative Satisfaction of ESI_TRIAM, Compared to ESI_DEXA

		ESI_TRIAM >ESI_DEXA	ESI_TRIAM = ESI_DEXA	ESI_TRIAM <ESI_DEXA	Total
Diagnosis	HIVD	35 (66.0)	8 (15.1)	10 (18.9)	53
	Stenosis	52 (60.5)	19 (22.1)	15 (1734)	86
Approach Method	Caudal	16 (55.2)	6 (20.7)	7 (24.1)	29
	Interlaminar	27 (60.0)	11 (24.4)	7 (15.6)	45
	Transforaminal	44 (67.7)	10 (15.4)	11(16.9)	65
Age (years)	<70	54 (65.9)	15 (21.1)	13 (15.9)	82
	≥70	33 (57.9)	12 (21.1)	12 (21.1)	57
Sex	Female	51 (59.3)	20 (23.3)	15 (17.4)	86
	Male	36 (67.9)	7 (13.2)	10 (18.9)	53

Note.—Data are numbers of patients, with the percentages in parentheses.

Total number of patients in this analysis is 139, because 23 patients could not answer the questionnaire about relative satisfaction due to lack of memory.

Abbreviations.—ESI_TRIAM: lumbar ESI using triamcinolone; ESI_DEXA: lumbar ESI using dexamethasone

Table A2.Subgroup Analyses: Comparison of Injection-free Interval between ESI_TRIAM and ESI_DEXA

		ESI_TRIAM	ESI_DEXA	P value
Diagnosis	**HIVD**	105.17 (90.05 to 120.29)	78.58 (60.63 to 96.54)	***p=0.02***
	Stenosis	86.14 (77.93 to 94.34)	76.52 (64.73 to 88.32)	*p=0.15*
Approach Method	**Caudal**	92.23 (79.68 to 104.78)	86.54 (73.22 to 99.85)	*p=0.53*
	Interlaminar	93.90 (76.97 to 110.85)	87.41 (64.59 to 110.23)	*p=0.56*
	Transforaminal	89.38 (77.55 to 101.22)	63.68 (47.99 to 79.36)	***P<0.01***
Age (years)	**<70**	97.11 (86.29 to 107.93)	79.13 (64.76 to 93.51)	***p=0.04***
	≥70	84.68 (74.61 to 97.74)	75.05 (61.54 to 88.57)	*p=0.18*
Sex	**Female**	92.78 (84.46 to 101.09)	75.74 (63.68 to 87.81)	***p=0.01***
	Male	89.52 (74.47 to 104.56)	79.69 (62.59 to 96.79)	*p=0.33*

Note.—Data include the arithmetic mean of the injection-free interval period (days), with the95% CI for the mean in parentheses.

Abbreviations.—ESI_TRIAM: lumbar ESI using triamcinolone; ESI_DEXA: lumbar ESI using dexamethasone

Table A3.Subgroup Analyses: Comparison of Additional Injection Frequency within Six Months between ESI_TRIAM and ESI_DEXA

		ESI_TRIAM	ESI_DEXA	P value
Diagnosis	**HIVD**	0.92 (0.70 to 1.145)	2.19 (1.80 to 2.59)	***p<0.01***
	Stenosis	1.19 (0.98 to 1.39)	1.33 (1.09 to 1.57)	*p=0.21*
Approach Method	**Caudal**	1.29 (0.95 to 1.623)	1.42 (1.07 to 1.79)	*p=0.36*
	Interlaminar	1.21 (0.91 to 1.52)	1.24 (0.86 to 1.63)	*p=0.88*
	Transforaminal	0.89 (0.65 to 1.12)	0.94 (0.61 to 1.28)	*p=0.74*
Age (years)	**<70**	1.02 (0.81 to 1.22)	1.34 (1.05 to 1.63)	***p=0.03***
	≥70	1.22 (0.97 to 1.48)	1.02 (0.75 to 1.30)	*p=0.12*
Sex	**Female**	1.16 (0.93 to 1.38)	1.35 (1.07 to 1.64)	*p=0.14*
	Male	1.05 (0.81 to 1.30)	0.95 (0.67 to 1.23)	*p=0.53*

Note.—Data are the arithmetic mean of the injection frequency within six months, with the 95% CI for the mean in parentheses.

Abbreviations.—ESI_TRIAM: lumbar ESI using triamcinolone; ESI_DEXA: lumbar ESI using dexamethasone

DISCUSSION

Theoretically, a particulate steroid could remain more persistently at a target site because of its local accumulative nature, resulting in a longer acting time and greater effect [3; 6; 16]. The results of our study support this theoretical expectation. According to our results, the relative satisfaction with the ESI_TRIAM was significantly better than that with the ESI_DEXA in the same patient. Furthermore, most of the patients who revisited the clinic early after ESI_DEXA were patients whose pain had been relatively well controlled with repetitive ESI_TRIAM for several years. In fact, the injection-free interval after ESI_TRIAM was significantly longer than that after ESI_DEXA in our study. The shorter injection-free interval of ESI_DEXA could imply a shorter duration of the effectiveness of ESI_DEXA and could be positively correlated with the increased numbers of repetition of the lumbar ESI. And the increased numbers of repetition of the injections could raise the possibility of ESI-related complications which would result in incurring additional costs and medical expenses from using the ESI. Therefore, further investigation is needed to determine

the differences between ESI_TRIAM and ESI_DEXA with respect to cost-effectiveness and social economy.

Interestingly, according to our results, the subgroup for whom the causing factor for LBP or lumbar radiculopathy was HIVD showed significantly shorter injection-free intervals and less additional injection frequency for ESI_TRIAM rather than for ESI_DEXA. Considering that the pain associated with HIVD is caused by acute inflammation at the specific region around the herniated disc, ESI using a particulate steroid (e.g., triamcinolone), which could stay more persistently at the target site during the acute inflammatory phase, could be more effective than ESI using a non particulate steroid. The injected steroid could decrease the inflammation around not only the compressed nerve roots but also the herniated disc. Therefore, the importance of local treatment at the target site during acute inflammatory phase might be further emphasized in the HIVD group.

Several previous studies[7; 13; 19] reported that there were no statistically significant differences in the effects between particulate and non particulate steroids. Even though they were not statistically significant, Dreyfuss et al.[7] reported similar

results to ours in cervical ESI, where triamcinolone was slightly more effective than dexamethasone. Those previous comparative studies were performed between two different patient groups. In fact, ESIs for lumbar radiculopathy can be performed repeatedly in a patient, and there is wide variability for that individual in the satisfaction with the treatments. Therefore, our comparative study, which evaluated the effectiveness of triamcinolone and dexamethasone for the same individual, has considerable clinical implications.

With better satisfaction from lumbar ESI, patients can overcome residual discomfort and can avoid a decompressive operation[1; 14]. Even though ESI using particulate steroids involves a serious risk for embolic infarction of the brain or spinal cord, the possibility of serious complications from ESI is lower in the lumbar area than in the cervical area [2; 8; 9; 11; 12; 15; 18; 20]. Because the variation when the artery of Adamkiewicz unusually arises from the lower vertebrae in the lumbar spine is rare, the possibility of inadvertent risk from intravascular injection is relatively low in the lumbar region [4; 8; 14]. According to the previous reports, methylprednisolone was the most frequently reported corticosteroid from which major

complications arose caused by embolic infarction. And complications from triamcinolone were relatively less frequently reported. Furthermore, the use of fluoroscopic guidance to check the needle position and the use of an injection of contrast material before the steroid injection to confirm the accurate needle position could be helpful in reducing the frequency of inadvertent risk from intravascular injection[4; 9]. Considering the rarity of major side effects and the greater patient satisfaction with the ESI_TRIAM, triamcinolone could be one of the candidates for ESI at the lumbar region.

Our study had several limitations. First, it was a retrospective cohort study, so there were some data losses resulting from incomplete data on retrospective chart review. The current effectiveness of ESI_DEXA after a six-month follow-up was evaluated, but the same follow-up period of ESI_TRIAM could not be evaluated. Because the visual analog scale (VAS) changes after ESI_TRIAM were incomplete, the comparison of the VAS changes could not be included. Nor could the changes of VAS after ESI_DEXA be checked during the circumstances of a phone interview. Second, the effectiveness measurement was

only based on the patients' satisfaction. There was no available measurement for functional outcome.

In conclusion, the relative satisfaction with ESI_TRIAM was significantly better than that with ESI_DEXA in the same patient, and the injection-free interval after ESI_TRIAM was significantly longer than that of ESI_DEXA. Given that the major side effects of lumbar ESI using triamcinolone are very rare, triamcinolone for ESI at the lumbar region could be a favorable candidate as an injection drug for lumbar ESI.

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국문 초록

목적: 요추 경막 외 스테로이드 주사요법으로 요추 통증 치료를 받는 환자를 대상으로 하여, 동일 환자에서 요추 경막 외 스테로이드 주사요법에 사용된 입자성 스테로이드 제제인 triamcinolone 과 비입자성 스테로이드 제제인 dexamethasone, 각 약제에 따른 치료 효과를 비교하는데 그 목적이 있다.

방법: 이 후향적 코호트 연구는 소속기관의 임상시험 심사위원회로부터 연구를 허가 받았으며 연구 참여에 대한 동의서를 면제 받았다. 2013 는 4 월부터 2013 년 5 월까지 dexamethasone 을 이용하여 요추 경막외 스테로이드 주사요법으로 요추 통증 치료를 받은 환자들 중, 최근 1 년 이내에 triamcinolone 을 이용하여 요추 경막외 스테로이드 주사요법으로 요추 통증 치료를 받은 경험이 있는 총 162 명 (남자: 여자 = 60:102; 평균연령, 66.3 세; 연령 범위, 27-90 세)의 환자를 대상으로 하였다. Dexamethasone 과 triamcinolone 각각을 이용한 요추 경막외 스테로이드 주사요법의 개인 내 상대적 만족도는 전화 설문을 통해 평가되었다. 또한 의무기록 분석을 통해 동일 환자에서 dexamethasone 과 triamcinolone 약제로 치료 받았던 각각의 기간 동안, 추가적 주사 요법 없이 지낸 기간과 6 개월간 요추 경막외

주사요법을 받은 빈도를 분석하여 비교하였다. 요추 통증을 일으킬 질환의 진단명과 경막외 스테로이드 주사요법의 접근 방법, 환자의 나이와 성별에 따라 하위집단 분석도 시행하였다.

결과: 두 약제간의 상대적 만족도가 평가 가능했던 139 명중 87 명(62.6%)의 환자는 triamcinolone 을 이용한 요추 경막외 스테로이드 주사요법에 대한 만족도가 dexamethasone 을 이용한 그것보다 높았다 (p=0.002). 또한 triamcinolone 을 이용한 경막외 주사요법으로 치료 받았을 때 추가적 주사요법 없이 지낸 기간(평균 기간 = 91.5 일) 이 dexamethasone 을 이용하여 치료 받았을 때 (평균 기간 = 77.3 일) 보다 통계적으로 유의하게 길었다 (p=0.01).

하위 집단 분석에서는 추간판 탈출증에 의한 요추 통증으로 치료받았던 환자 군과 경추간공 접근법을 통한 경막외 주사치료를 받은 환자군, 70 세 미만의 환자군 및 여자 환자들에서 triamcinolone 을 이용한 경막외 주사요법으로 치료 받았을 때 추가적 주사요법 없이 지낸 기간 이 dexamethasone 을 이용하여 치료 받았을 때보다 통계적으로 유의하게 길었다 ($p < 0.05$). 또한 추간판 탈출증으로 경막외 주사 치료를 받은 환자군 및 70 세 미만의 환자군 에서는 triamcinolone 으로 치료를 받을 때 6 개월간 요추 경막외 주사요법을 받은 빈도가 dexamethasone 으로 치료를 받을 때보다 유의하게 낮았다 ($p<0.05$).

결론: 동일 환자에서 triamcinolone 을 이용한 요추 경막외 주사요법의 상대적 만족도가 dexamethasone 에 비해 높았으며, triamcinolone 으로 치료를 받았을 때 추가 주사치료 없이 지낸 기간이 더 길었다. 따라서 입자성 스테로이드에 의한 치명적인 부작용의 빈도가 요추에서의 경막외 스테로이드 주사요법에서는 극히 드물다는 것을 고려할 때, 요추 경막외 스테로이드 주사요법의 치료제로서 triamcinolone 의 사용은 긍정적으로 고려되어야겠다.

주요어 : 요추 경막외 주사요법, 스테로이드, 입자성
학 번 : 2013-30821