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Effects of Artcure Diffusional Patch application on pain and functional status in lumbar disc herniation patients: a prospective randomized controlled study

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Background/aim: The aim of this study was to assess the efficacy of the Artcure Diffusional Patch, which contains a mixture of 6 herbal oils (oleum thymi, oleum limonis, oleum nigra, oleum rosmarini, oleum chamomilla, oleum lauriexpressum) and has a hypoosmolar lipid structure, in the conservative treatment of lumbar disc herniation patients and to show the advantages and/or possibility of using this as an alternative method to surgery.

Materials and methods: Of the 120 patients enrolled, 79 clinically diagnosed patients were included in the study. Clinical evaluations were performed on patients who had findings of protrusion or extrusion in their magnetic resonance results. The treatment group was treated with the Artcure Diffusional Patch while the control group received a placebo transdermal diffusional patch. The functional state of patients was measured using the Oswestry Disability Index and pain intensity was measured with a visual analog scale as primary outcomes. Secondary outcomes of the study were Lasegue's sign, the femoral stretching test, and paravertebral muscle spasm.

Results: The treatment group showed a dramatic recovery in the first month following the application in regards to Oswestry Disability Index scores and visual analog scale values. The patients treated with the Artcure Diffusional Patch showed a statistically significant difference in recovery as compared to the control group.

Conclusion: These findings suggest that the Artcure Diffusional Patch may be an alternative for the conservative treatment of lumbar disc herniation with radiculopathy.

Key words: Lumbar disc herniation, Artcure Diffusional Patch, Oswestry Disability Index

1. Introduction

Among Western societies 84% of adults suffer from low back pain at some time in their lives (1). Low back pain is the most frequent reason for disability in the population below the age of 45 (2). The treatment costs for low back pain are a significant part of medical costs and at about 34 billion dollars; by adding the economic loss due to workforce loss, this number increases to 100 billion dollars in the United States (3,4). Lumbar disc herniation with associated radiculopathy (LDHR) ranks first among the diseases that cause low back pain. For this reason, an inexpensive, noninvasive, and efficient treatment method is required in order to reduce and delay surgical interventions of LDHR patients and minimize the workforce loss during the period until surgical intervention.

Lumbar disc herniation is the displacement of the nucleus pulposus by the breaching of the annulus fibrosus (5). With increasing age disc degeneration and disc height loss occur by the loss of proteoglycan and the effects of proinflammatory cytokines (6). As a result of these, clinical signs such as pressure on nerve roots and the spine occur. The purpose of treatment is reducing the pain and increasing the functional activity by removing the pressure on the nerve roots by either surgical or conservative methods.

The decision between surgical and nonsurgical management of LDHR can be challenging for both the patient and the treating physician. Generally surgical intervention is suggested to patients with acute and progressive neurological deficit and those who are nonresponsive to conservative treatments (7). In light of the costs of surgical treatments and the scale of possible complications, noninvasive treatment becomes the best option. Since the intervertebral discs are the largest avascular structures of the body, nourishment is supplied by diffusion. Because of this avascularity, there is no possibility for spontaneous recovery (8).

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The Artcure Diffusional Patch (ADP) contains a mixture of 6 herbal oils (oleum thymi, oleum limonis, oleum nigra, oleum rosmarini, oleum chamomilla, oleum lauriexpressum) and has a hypoosmolar lipid structure. These hypoosmolar fatty acids have been used in therapy before, but this is the first time that they are being used in combination for the treatment of lumbar disc herniation. These fatty acids are not dosed sufficiently for therapeutic use. These oil ingredients of ADP increase the membrane permeability of the herniated nucleus pulposus, decrease the intraosmotic pressure, and cause water loss by diffusion. By these antiinflammatory and antiedema effects, the mass decreases. By using dextrin palmitate, the hypoosmolar fatty acids were formulated as a gel. As the dissolvent of dextrin palmitate, liquid paraffin was used. The purpose of this study was to assess the efficacy of the ADP in the conservative treatment of patients with lumbar disc herniation and to show the advantages of/possibility of using it as an alternative method of nonsurgical intervention to surgery.

2. Materials and methods

The study was conducted prospectively in 2014 and 2015 as a randomized placebo controlled trial with patients admitted to the orthopedics, traumatology, and physiotherapy clinics at the Yıldırım Beyazıt University Atatürk Training and Research Hospital, Ankara, Turkey. The study was performed under the terms of the Declaration of Helsinki and the protocol was approved by the ethics committee of the institution (approval date and number: 03.09.2014–26379996/151).

Patients were eligible if they were in the age range of 20–60 years, had been referred for pain in one or two lower extremities that caused functional disability, had findings in magnetic resonance results such as protrusion or extrusion, had radiological findings that conformed with discogenic sciatica that followed a dermatomal distribution, and had low back pain refractory to physiotherapy and NSAIDs. Sciatica was defined as the presence of constant or intermittent pain in one or both legs, radiating below the knee. Signs of nerve root irritation (a positive straight-leg test, defined as reproduction of radicular pain by elevation of the leg) or nerve root compression (motor, sensory, or reflex deficits), or both, had to be present with computed tomographic evidence of a herniated nucleus pulposus at a level corresponding to the symptoms and clinical findings.

Patients were excluded if they had lumbar surgery, spinal stenosis or deformity (scoliosis, spondylolysis, vertebral fracture sequelae), loss of motor activity at ≥3/5 in any lower extremity muscle section, uncontrolled acute or chronic systemic diseases, or atopic skin.

Outcomes were assessed using a visual analog scale (VAS) for the degree of pain, while the Oswestry Disability Index (ODI) was used in order to evaluate the functional state, patient satisfaction, return to military duty, and need for additional surgery. Lasegue's sign and femoral stretch test results were also recorded. Magnetic resonance imaging was evaluated by two experienced neuroradiologists and a radiological diagnosis was made. Each patient was examined by the same physician throughout the trial. The physicians and nurses involved in these assessments were unaware of the treatment received.

Secondary outcomes were measured by physical examination (disability of movement, test of Lasegue's sign, femoral stretching test, paravertebral muscle spasm). The VAS, ODI, and physical examinations were administered before the application of the patches, on the third day after application, and the first month thereafter. If a patient's functional state recovery, pain reduction, and negative score in the Lasegue test were more than 50%, the recovery was accepted as significant (9,10).

Demographic information, medical history, and physical examination findings of patients were recorded and served as the baseline.

Randomization took place after we had obtained written informed consent from the study participants and gathered baseline information. The assignment scheme was generated from the patient's hospital files. The patients were divided into two groups by using the last numbers of the patient's hospital files: odd numbers were included in the ADP group (treatment group) and patients with even numbers were included in the control transdermal diffusional patch (TDP) group (control group).

The patches used as TDPs and applied to the patients in the control group were similar to the ADP in appearance and size. The same inactive ingredients in the gel structure of the ADP (dextrin palmitate derivative and liquid paraffin) were used in TDPs but as for liquid components to change the osmotic gradient, glycerin was used instead and evenly (11).

Ninety-seven patients (48 males, 49 females) with a mean age of 43.1 years (range: 18–60 years) were admitted to the study. The average duration of complaints of low back pain was 2 years (range: 0.5–20 years) and 50.6% of patients had right while 49.4% of patients had left radicular pain. There was no statistically significant difference between the two groups regarding the demographic data of the level of hernia and anatomical type of herniation. The patients in the ADP group mostly had multiple levels of hernia, while the patients in the TDP group mostly had a single level of hernia ($P = 0.001$). According to the anatomical type of herniation, the patients in the ADP group mostly had bulging-type hernias, while the patients in the TDP group had more protruded discs ($P < 0.001$) (Table 1).

The superior border of the iliac crest was palpated while the patients were lying in a prone position and the

Table 1. Demographical data of groups. Independent t-test (bootstrap) - Mann–Whitney U test (Monte Carlo) - Fisher exact test (exact) - Pearson chi-square test (Monte Carlo). Average data ± standard deviation; median (range); n (%).

		Control	Experiment	P-value
		n = 46 (47.4)	n = 51 (52.6)	
Age		42.3 ± 9.59	43.8 ± 10.77	0.458
Sex	Female	24 (52.2)	25 (49.0)	0.840
	Male	22 (47.8)	26 (51.0)	
BMI		26.1 ± 4.26	27.8 ± 4.09	0.053
Smoking	No	29 (63.0)	33 (64.7)	1
	Yes	17 (37.0)	18 (35.3)	
Marital status	Single	10 (21.7)	6 (11.8)	0.273
	Married	36 (78.3)	45 (88.2)	
Duration of low back pain (years)		2 (0.5–12)	2 (0.5–20)	0.452
Radicular pain	Right	22 (47.8)	26 (51.0)	0.840
	Left	24 (52.2)	25 (49.0)	
Level of herniation	Multiple	8	26	0.001
	Single	38	25	
Type of herniation (anatomically)				<0.001
	Protruded	34	26	
	Extruded	12	25	
Type of herniation (location)	Central	21	26	0.053
	Posterolateral	25	25	

L4–5 level was determined. The level of disc pathology was identified by drawing a line with a dermal pen. The center of the patch was placed on the marked area (Figure 1). The patients were hospitalized for 24 h and held in a supine position. They were allowed to stand up for a maximum of 3 times each hour during 24 h. All of the patients showed full compliance with the study protocols and exercise program. None of the patients needed bracing applications.

The patients rated the perceived degree of overall improvement or deterioration on a descriptive seven-item scale that ranged from very marked improvement to very marked deterioration. The intensity of leg pain in the week preceding the visit was assessed on a VAS ranging from 0 (no pain) to 100 (worst pain possible). The patients completed two components of the McGill Pain Questionnaire. The first component measures the present intensity of pain on the basis of the response to one question, recorded as a number from 0 (no pain) to 5 (excruciating pain). The second component is a pain-rating index involving 77 pain descriptors (e.g., lancinating, cramping, and burning) grouped into 20 categories. The descriptors in each category are ranked numerically according to the severity of pain. Patients can choose no more than one descriptor per category. The score for the pain-rating index, which corresponds to the sum of the numerical values of the descriptors chosen by the patient, ranges from 0 (no pain) to 77 (the most severe pain in every category).

Functional disability was assessed with the Oswestry Low Back Pain Disability Questionnaire and the Sickness Impact Profile, both slightly modified by adding "and/or leg" to all statements that contained the word "back". The Oswestry Low Back Pain Disability Questionnaire has 10 sections, on walking, sleeping, and social activities . The overall score ranges from 0 to 100, with a score of 20 or less indicating minimal disability for which no treatment is usually indicated and higher scores indicating greater disability. The Sickness Impact Profile measures perceived health status and changes in functional status due to sickness. It consists of 136 questions grouped into 12 categories (e.g., physical dimensions and psychosocial dimensions). Both instruments have been shown to be reliable and sensitive to changes in patients with low back pain. The patients also reported the number of days in the previous 2 weeks when they had limited their activities because of back or leg pain.

During data analysis, SPSS 22.0 (IBM Corp., Armonk, NY, USA) and PAST3 (Øyvind Hammer, Natural History

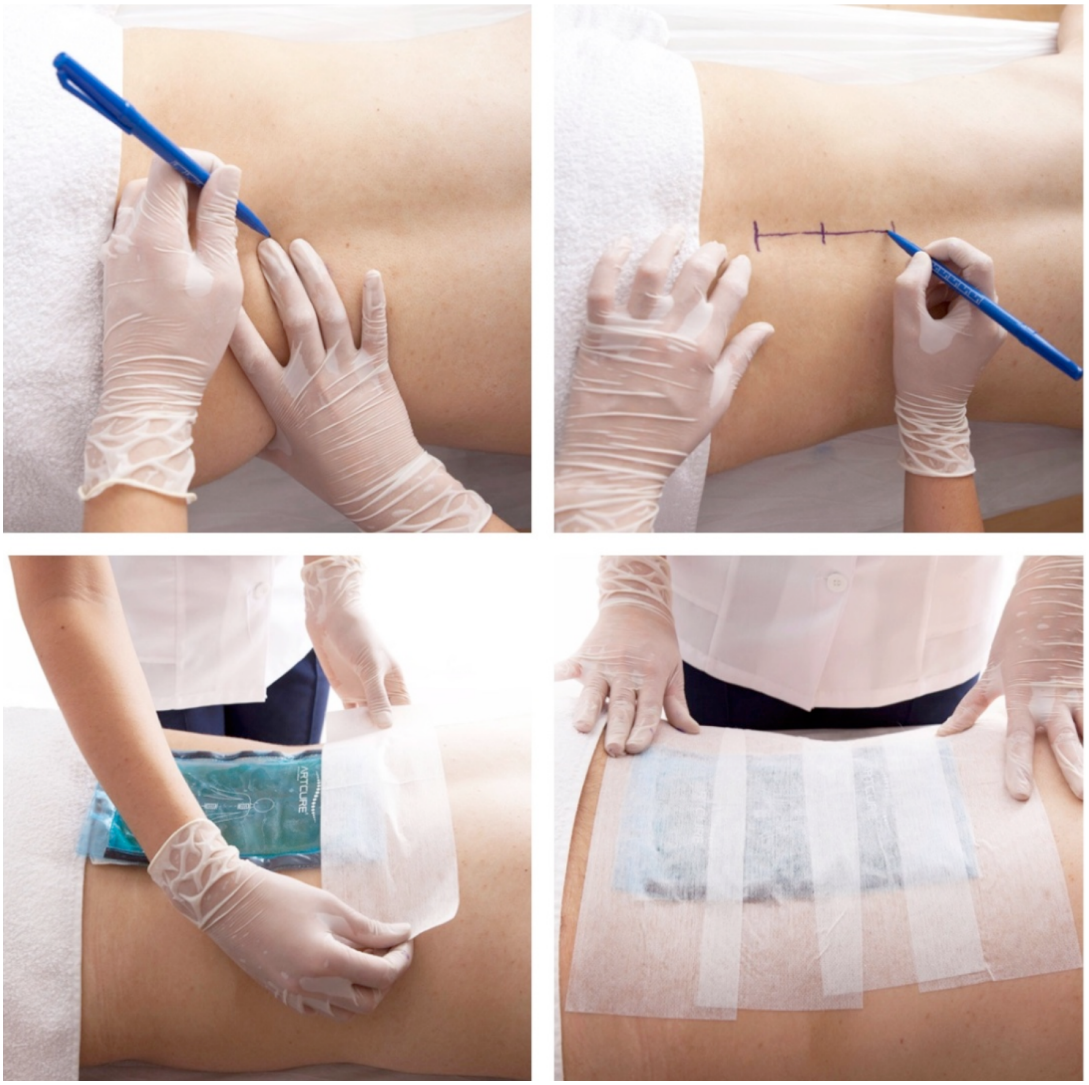

Figure 1. ADP application.

Museum, University of Oslo, Oslo, Norway) were used, and for power analysis the G Power program was used. The Shapiro–Wilk test was used for the compliance of normal distribution of univariate data and the Mardia (Doornik–Hansen omnibus) test was used for the compliance of normal distribution of multivariate data. The Levene test was used for homogeneity of variance. The independent-samples t-test was used with bootstrap results in order to compare two independent groups and the Mann–Whitney U test was used for simulation techniques. The general linear model-repeated ANOVA test was used with Cochran's Q test in order to measure measurements of dependent variables repeated more than two times. Nonparametric (Miller) post hoc tests and least significant difference (LSD) tests were used for post hoc analysis. For comparison of categorical data Pearson chi-square and Fisher exact tests were used and tested by Monte Carlo simulation technique. For the determination of the most important risk factor among the significant categorical risk factors the odds ratio was used. Quantitative data were expressed as mean ± standard deviation and median (maximum–minimum) values and were tabulated. Categorical data were expressed as n (number) and percentage (%). The 95% confidence levels were set and P values were accepted to be significant at $P < 0.05$.

Fifteen percent of the total patients admitted to these clinics complained of low back pain. Therefore, two groups were formed presuming this rate as 20% in order to increase the power of our sample size.

ADP, which was applied to Group 1, contains a mixture of 6 herbal oils (oleum thymi, oleum limonis, oleum nigra, oleum rosmarini, oleum chamomilla, oleum lauriexpressum) and has a hypoosmolar lipid structure.

3. Results

A total of 120 patients were enrolled (Figure 2). Three patients had had lumbar surgery before and 2 patients had scoliosis deformation; therefore, they were excluded from the study. Eighteen patients declined to participate in the study for various reasons. The remaining 97 patients were randomly divided into two groups. During the study, 11 of 51 patients who received the ADP and 7 of 46 patients who received the TDP were excluded due to noncompliance. Consequently, 40 patients who received the ADP and 39 patients who received the TDP were evaluated. The baseline characteristics were similar in the two groups (Table 1).

After the patients were evaluated clinically and radiologically and all of the data were gathered at the final visit in March 2016, the study was terminated.

When comparing the ODI scores, VAS values, and physical examination findings of the treatment and control groups, there was statistically significant difference only in paravertebral muscle spasms ($P = 0.035$). There were no statistically significant differences between the other values (Table 2).

In the treatment group, a dramatic recovery was achieved in the first month with respect to ODI scores and VAS values (Table 3). In this group, the average VAS value was 9 (range: 3–10) before application and it decreased to 5 (range: 2–10) at the end of first month ($P < 0.042$). The average ± standard deviation ODI score was 59.2 ± 13.37, reduced to 33.4 ± 10.13 at the end of the first month ($P < 0.001$). In the treatment group, patients who showed positive simple leg raising and femoral stretching tests were 80% and 77.5%, 40% and 37.5%, and 10% and 15% before the application, on the third day, and at the end of the first month, respectively ($P < 0.001$). A significant recovery was seen in the motion gap between lumbar and articular faces when comparing the findings before the application, on the third day, and in the first month ($P < 0.001$).

Regarding the patients in the TDP group, VAS values and ODI scores had a statistically significant minimal decrease when compared with the baseline values. There were no statistically significant differences except for paravertebral muscle spasms and the femoral stretching test (Table 4).

There was a statistically significant difference between the two groups before the application and on the third day after application (Table 5).

Comparing the clinical features of patients on the third day after the application with all physical examination findings and scores, a statistically significant difference between the patients in the ADP group and the patients in the TDP group was seen (Tables 3–5).

Two patients from the TDP group developed bullous lesions with serous fluid. They were treated with topical medications.

In conclusion, we found that application of ADP, as compared with the control TDP, showed better improvement in leg pain and sensory deficits.

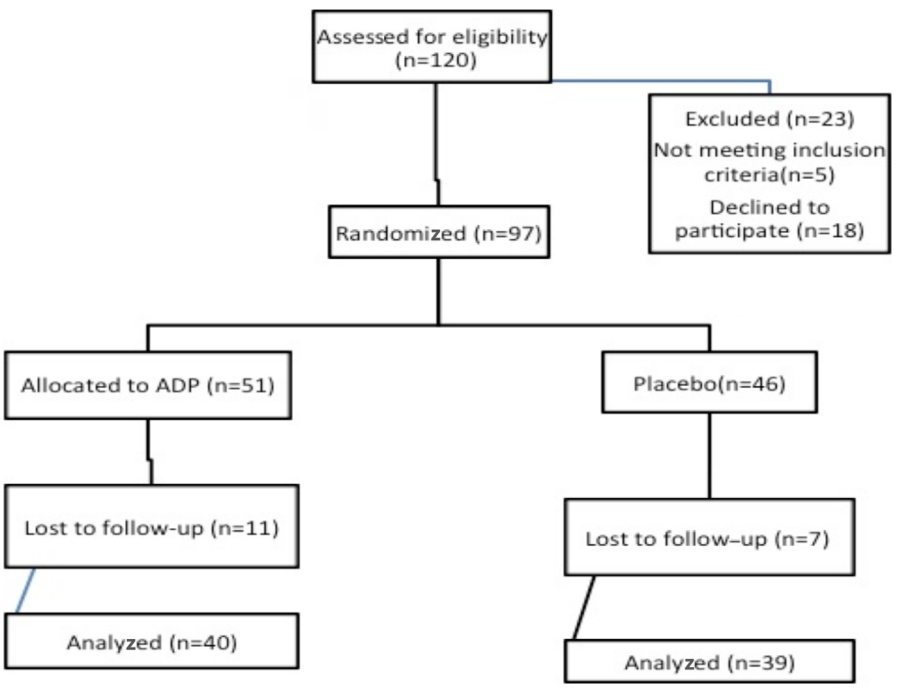

Figure 2. Flowchart of the study and follow-up of patients.

Table 2. Clinical features of groups before application. Independent t-test (bootstrap) - Mann–Whitney U test (Monte Carlo) - Fisher exact test (exact). Average data ± standard deviation; median (range); n (%). [a]: Odds ratio (95% confidence interval for odds ratio); [o]: reference taken for odds ratio.

		Control	Experiment	P-value
		46 (47.4)	51 (52.6)	
ODI		61.8 ± 11.42	60.9 ± 13.15	0.724
VAS		8 (3–10)	10 (3–10)	
SLR	Positive	36 (78.3)	42 (82.4)	0.620
	Negative	10 (21.7)	9 (17.6)	
K-SLR	Positive	32 (69.6)	36 (70.6)	1
	Negative	14 (30.4)	15 (29.4)	
Flexion	Normal	18 (39.1)	20 (39.2)	1
	Disabled	28 (60.9)	31 (60.8)	
Extension	Normal	19 (41.3)	19 (37.3)	0.835
	Disabled	27 (58.7)	32 (62.7)	
Right L flexion	Normal	19 (41.3)	22 (43.1)	1
	Disabled	27 (58.7)	29 (56.9)	
Left L flexion	Normal	19 (41.3)	22 (43.1)	1
	Disabled	27 (58.7)	29 (56.9)	
Paravertebral muscle spasm	Yes[o]	36 (78.3)	48 (94.1)	0.035
	No	10 (21.7)	3 (5.9)	4.4 (1.1–17.2)[a]
Femoral stretching test	Positive	31 (67.4)	38 (74.5)	0.504
	Negative	15 (32.6)	13 (25.5)	

4. Discussion

The TDP method has been known for a long time and is used in many medical fields such as nicotine and postmenopausal hormone replacement, pain treatment, and antihypertension medications (12). Fentanyl has been used transdermally in LDHR treatment and recovery of symptoms of patients has been reported (13,14). However, the method that we used in this case is a completely new approach in which the ADP enhances the systemic circulation. The findings of this study suggest that the disintegrated herniated disc absorbs the active ingredients by diffusion and this decreases the intraosmotic pressure of the herniated nucleus pulposus and results in water loss.

According to the findings of this study, the patients in the treatment group with sciatica and LDHR showed significantly important clinical recoveries when compared with the control group in regards to baseline values. When we examined the difference before application and at the third day after application, there was a significantly higher recovery rate in the ADP group than the control group regarding the ODI scores, VAS values, and physical examination findings. For the patients in the ADP group, ODI scores before the application, on the third day after application, and at the first month after application were 59.2, 44.8, and 33.4, respectively ($P < 0.001$, Table 3). The median of VAS values before the application, on the third day after application, and at the first month after application were reduced to 9, 7, and 5. These values support the efficiency of ADP treatment. The mechanism of action of ADP is supposed to be by reducing the osmolarity of the disc by the fatty acids that reach the disintegrated disc and have a lower solute concentration than water. Thus, the fatty acids were formed with dextrin palmitate, which reaches the herniated nucleus pulposus and produces a hypoosmolar medium. The water inside the herniated nucleus pulposus passes to the hyperoosmolar medium so that the water content of the disc decreases and the mass reduces.

In the literature, there are publications indicating that even massive herniated discs can be reduced and reabsorbed by long-term follow-ups by conservative treatment (15 – 21). Significant reduction of symptoms in conservatively followed patients is seen in the long term (16–18). Comparing the conservative and surgical treatments for LDHR patients, there is no superiority of surgery over long-term conservative treatment (22).

Table 3. The data before and after application in the experiment group. General linear model-repeated ANOVA (Wilks' lambda); post hoc test: LSD; Cochran's Q test; post hoc test: nonparametric Miller post hoc test. Average data ± standard deviation; median (range); n (%).

		Preoperative = I	3rd day = II	1st month = III	P-value			
		n = 40	n = 40	n = 40	I–II	I–III	II–III	General
ODI		59.2 ± 13.37	44.8 ± 15.61	33.4 ± 10.13	<0.001	<0.001	<0.001	<0.001
VAS		9 (3–10)	7 (2–10)	5 (2–10)	<0.001	0.042	<0.001	<0.001
SLR	Positive	32 (80.0)	16 (40.0)	4 (10.0)	0.001	<0.001	0.016	<0.001
	Negative	8 (20.0)	24 (60.0)	36 (90.0)				
K-SLR	Positive	32 (80.0)	16 (40.0)	4 (10.0)	<0.001	0.001	0.016	<0.001
	Negative	8 (20.0)	24 (60.0)	36 (90.0)				
Flexion	Normal	15 (37.5)	25 (62.5)	33 (82.5)	0.019	<0.001	0.085	<0.001
	Disabled	25 (62.5)	15 (37.5)	7 (17.5)				
Extension	Normal	14 (35.0)	25 (62.5)	32 (80.0)	0.006	<0.001	0.148	<0.001
	Disabled	26 (65.0)	15 (37.5)	8 (20.0)				
Right lateral flexion	Normal	17 (42.5)	28 (70.0)	32 (80.0)	0.003	<0.001	0.704	<0.001
	Disabled	23 (57.5)	12 (30.0)	8 (20.0)				
Left lateral flexion	Normal	17 (42.5)	28 (70.0)	32 (80.0)	0.003	<0.001	0.704	<0.001
	Disabled	23 (57.5)	12 (30.0)	8 (20.0)				
Paravertebral muscle spasm	Yes	40 (100.0)	12 (30.0)	8 (20.0)	<0.001	<0.001	1	<0.001
	No	0 (0.0)	28 (70.0)	32 (80.0)				
Femoral stretching test	Positive	31 (77.5)	15 (37.5)	6 (15.0)	<0.001	<0.001	0.082	<0.001
	Negative	9 (22.5)	25 (62.5)	34 (85.0)				

The pain of the patient may partially increase after the 8th hour of ADP application until the 24th hour after the application. We inform the patients about this in order to ensure their compliance. The reason for this may be that the hypoosmolar fatty acids diffuse to the herniated disc and increase the volume of the disc during the first 24 h. We generally see that the symptoms start to decrease after this period when the diffusion of water starts due to hypoosmolarity. We also saw that clinical recovery is better at the end of the first month of ADP application than at the third day. This finding supports the hypothesis that the hypoosmolar property of the disc is maintained until the end of the first month.

Although we did not randomize the groups, we found that the only statistically

significant difference between the two groups before the application was the higher rate of paraspinal muscle spasm in the ADP group. Paraspinal muscle spasms may occur when the disc hernia is especially anterior to root irritation (23). In addition, the fact that the disc herniation is added to other possible physical examination findings may lead to the patient feeling more pain. However, the statistically significant difference between the groups before ODI administration suggests that the clinical status of the groups may be similar.

Transforaminal endoscopic discectomy and microdiscectomy were performed in a study conducted with the patients' ODI values, in which the preoperative ODI value of transforaminal endoscopic discectomy patients was 43 and the postoperative ODI value was 22, and the preoperative ODI value of the patients who underwent microdiscectomy was 43 (24). In another study, 31 patients underwent laser-assisted discectomy and the patients were assessed by preoperative and postoperative ODI scales. The preoperative ODI value of the patients was measured as 60 postoperative ODI values of 11 (25). According to Ahn et al., tubular discectomy used in lumbar disc herniation was evaluated and preoperatively the ODI score was 84, while the postoperative ODI score was 27 (26) In our study, the ODI score fell from 59 before application to 33 after application. When considering the possible complications and costs of all these surgical methods, it is thought that TDP application is effective in lumbar disc hernia treatment.

Proper patient selection is also an important factor in the success of clinical treatment of LDHR patients

Table 4. The data before application and 3rd day after application in control group. Independent t-test (bootstrap) - Mann–Whitney U test (Monte Carlo) - Fisher exact test (exact). Average data ± standard deviation; median (range); n (%).

		Control		P-value
		Preop	3rd day	
ODI		61.8 ± 11.42	52.2 ± 12.5	<0.001
VAS		8 (3–10)	7 (2–10)	<0.001
SLR	Positive	29 (74.4)	25 (64.1)	0.219
	Negative	10 (25.6)	14 (35.9)	
K-SLR	Positive	29 (74.4)	24 (61.5)	0.063
	Negative	10 (25.6)	15 (38.5)	
Flexion	Normal	17 (43.6)	18 (46.2)	1
	Disabled	22 (56.4)	21 (53.8)	
Extension	Normal	17 (43.6)	18 (46.2)	1
	Disabled	22 (56.4)	21 (53.8)	
Right L flexion	Normal	16 (41.0)	18 (46.2)	0.500
	Disabled	23 (59.0)	21 (53.8)	
Left L flexion	Normal	17 (43.6)	19 (48.7)	0.500
	Disabled	22 (56.4)	20 (51.3)	
Paravertebral muscle spasm	Yes	30 (76.9)	21 (53.8)	0.004
	No	9 (23.1)	18 (46.2)	
Femoral stretching test	Positive	27 (69.2)	20 (51.3)	0.016
	Negative	12 (30.8)	19 (48.7)	

Table 5. The difference between groups before application and the third day after application .General linear model-repeated ANOVA (Wilks' lambda) - independent t-test (bootstrap) - Mann–Whitney U test (Monte Carlo) - Fisher exact test (exact). Average data ± standard deviation; median (range); n (%). Odds ratio (95% confidence interval for odds ratio); °: reference taken for odds ratio.

		Control	Experiment	P-value
ODI	Preoperative	61.8 ± 11.42	60.9 ± 13.15	0.724
	3rd day	52.2 ± 12.5	46.0 ± 15.4	
	difference	8.2 ± 7.7	14.2 ± 12.9	0.010
VAS	Preoperative	8 (3–10)	10 (3–10)	<0.001
	3rd day	7 (2–10)	7 (2–10)	
	difference	1 (2–4)	2 (1–8)	0.003

when comparing the physical examination results, ODI scores, and VAS values of ADP-treated patients with the control group. We prefer the ADP in patients with clinically diagnosed sciatica with LDHR and radiologically diagnosed protruded and extruded discs. From the location point of view, it should be applied to the patients with central and posterolateral disc hernias. It should not be applied to patients with stenosis in the vertebral canal, mechanic vertebral instability, protrusion, calcification, lateral access stenosis, advanced motor deficit, or sphincter defects.

Our study had some limitations. Even though there was a placebo control group, comparisons with other control groups such as other lumbar disc hernia treatments (surgery, epidural steroid injection, etc.) could increase the power of the study. A longer study period may

provide more information about the efficacy of the ADP. Additionally, studies that show the efficacy of the ADP radiologically could provide more objective data.

In conclusion, ADP application has achieved successful clinical results for the conservative treatment of LDHR. It may become a candidate for alternatives of conservative treatment of LDHR. Clinical trials with more subjects and a longer period have to be performed in order to support the effectiveness of the ADP in the treatment of lumbar disc herniation.

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